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A NATIONAL PHYSICAL LABORATORY.

THE issue of the report of the Treasury Committee appointed last year to consider the question of founding a national physical laboratory marks, we hope, a very decided step forward in this matter. Our readers will remember that the appointment of this Committee was the result of a strong and numerous deputation to Lord Salisbury from various scientific bodies, which drew his attention to the importance of such institutions, and the value of the results obtained by them in other countries; conspicuous examples being, of course, the Bureau International des Poids et Mésures in Paris, and the Physikalish-Technische Reichsanstalt at Charlottenburg. The Committee, small but highly representative, consisted of Lord Rayleigh, Sir Courtenay Boyle, Sir Andrew Noble, Sir John Wolfe Barry, and Messrs. W. C. Roberts-Austen, Robert Chalmers, A. W. Rücker, Alexander Siemens, and T. E. Thorpe. By the terms of reference the Committee had to consider two questions: whether it is desirable to establish a laboratory for verifying instruments, for maintaining standards, and to test materials; and whether such a laboratory should be associated with any existing public institution. Notwithstanding the first question, the constitution of the Committee clearly indicated that the Treasury accepted in principle the foundation of the laboratory, and only desired information as to the best way of realising the scheme. The Committee have accordingly in their report dealt mainly with the mode of establishment, and have said little as to the reasons which should induce the Government to undertake it at all. They summarise their conclusions as follows:—

1. That a public institution should be founded for standardising and verifying instruments, for testing materials, and for the determination of physical constants.

2. That the institution should be established by extending the Kew Observatory in the Old Deer Park, Richmond, and that the scheme should include the improvement of the existing buildings, and the erection of new buildings at some distance from the present Observatory.

3. That the Royal Society should be invited to control the proposed institution, and to nominate a governing body, on which commercial interests should be represented, the choice of the members of such body not being confined to Fellows of the Society.

4. That the permanent secretary of the Board of Trade should be an *ex officio* member of the governing body; and that such body should be consulted by the Standards Office and the Electrical Standardising Department of the Board of Trade upon difficult questions that may arise from time to time, or as to proposed modifications or developments.

We think no one could very well find fault with these recommendations. Some would like, no doubt, to see the institution founded on the American scale, but Lord Salisbury, in his reply to the deputation, more than suggested that, if the proposal was to be acted on, the pecuniary

demands must be modest, and must be based on the cost of establishing and maintaining commercial standards of measurement. There is no indication in the report of the extent of the buildings, or the number of the staff contemplated, nor anything more than a general idea of the range of physical data whose investigation might be undertaken. These questions hardly come within the reference, but clearly the Committee, before writing the first clause of their concluding summary, must have formed some idea of the extent to which they could be allowed to carry on scientific research with the machinery of political administration. We imagine that their proposal to make the Royal Society the controlling body will meet with general approval. Few public bodies have sufficient intellectual clearness of vision to determine every question strictly on its own merits, never allowing a side issue or indirect object to affect a decision. Jobbery, using the word in a Pickwickian sense, is, in 19 cases out of 20, due to want of mental lucidity, not of probity. For intellectual vigour and public spirit, there is probably no body in England more distinguished than the Council of the Royal Society, and their administration would command general confidence. A late well-known philosopher held that the scientific men, and not the ecclesiastics, are the body now commissioned to keep alight the lamp of moral and religious truth. For a matter of this kind a Government department is apt to lack the wisdom of wide human sympathy.

We should have liked to know more of the views of the Committee as to what the work of this laboratory is to be, than that it will take over and extend the work now being done at Kew, and in the Board of Trade laboratories, of calibrating and examining measuring apparatus. It is quite clear, as is pointed out in the report, that a large number of important problems in physical measurement are not dealt with quite as well as they might be. They are too dull and laborious to attract a private investigator, or they do not offer the incentive of possible scientific reputation. The results of commercial problems, if worked out by commercial firms, cannot be protected, or are too valuable to be published. In many cases a firm has the will to undertake the expense of experiment, and the public spirit to publish the results; but the heads of the firm are not competent to indicate the problem to their subordinates, and so the necessary direction and initiation are wanting. The machinery of a scientific director, with a staff of skilled assistants, and a complete plant organised for the purpose of stating and solving any physical problems presented to them, regardless of the intellectual or pecuniary interest of the investigator, will obviously be very useful; but by what arguments Prof. Rücker and his fellows persuaded Lord Salisbury that it is the function of Government to provide such a machine is not very clear, though we are glad to think it has been possible to do it. Perhaps the explanation is that no body in England is more in want of the institution than the Government itself. The administration of an empire provides an endless succession of scientific problems. The alcoholic strength of beer, the flashing point of petroleum, the electrolysis of water pipes, the nautical almanack, tropical agriculture, the length of the yard, the adulteration of food, represent large groups of scientific problems which have been presented for solution in the first case to men who are simply political administrators. We know how many of these have been dealt with, in how tentative and piecemeal a fashion, and with what success. The little building in Greenwich Park and the old board of longitude have grown in spite of the economy of Admiralty boards into the most famous, and, for its importance, the worst-housed observatory in the world. Kew Gardens is largely a consulting establishment for the assistance of the Colonial Office, and we believe no small part of the work of its staff is the clerical work of a Government department. The incessant work of Major Cardew's office, and of the Somerset House laboratories is well known. The metallurgical laboratory of the Mint is the source of much of our recent knowledge of alloys and of steel. Well-equipped Government establishments for dealing with specific classes of scientific questions are nothing new, and advance in knowledge is their necessary by-product. From the point of view of a Government, however, it is only a by-product, and we imagine the Treasury looks jealously on any proposal to assign fresh funds to scientific research in any existing establishment.

The Government buying departments are continually in want of technical advice and scientific experiments to guide them in specifying or accepting goods from contractors, and in many cases have access to no suitable authority. All manufacturers who have worked for Government departments know that inspecting officers have continually to decide questions on which they do not possess all the information they would like to have, which in some cases does not exist. The long controversy on India-rubber cables, their peculiar merits, and occasional inexplicable failures, provides just the sort of problem that a national laboratory might take up, and it can hardly be doubted that chemists could devise some means of testing India-rubber that would remove the present uncertainty about the trustworthiness of any particular sample of cable. Such a result would be of immense value to all concerned. We are inclined to think that the problems submitted to this laboratory will be principally in molecular physics. Mechanics, as a science, is so perfect and so widely understood, that its problems do not require a specially trained or organised body to deal with them. A Government establishment is not necessarily well fitted to deal with such new and complex problems as were presented by submarine telegraphy, by the dynamo, or by the determination of the ohm. In these cases individual genius must be looked to to indicate the mode of solution, and then the machinery of an organised and equipped laboratory can take up the detail work more effectively than any private resources. This kind of problem does not occur every day, while the permanence of alloys, the composition of Leclanché cells, the purity of gums and oils, and the mechanical strength of materials have to be dealt with continually.

The Committee clearly contemplate that many more problems will be presented to the laboratory than it could deal with, and we have no doubt that if the institution commands respect by its efficiency this will be the case. The report proposes to deal with the difficulty of selecting the work by means of a highly qualified director, a strong committee, and the supervision of the Royal Society; and, by appointing to the committee members engaged in trade, to counteract the inevitable tendency of a scientific body to purely scientific questions. The reference of the report to an extension of the magnetic work organised from Kew, which has received so much of Prof. Rücker's attention, is a

case of the kind. It would be difficult to name a branch of science of smaller practical importance or of less promise of useful development than that of the earth's magnetic field. Its scientific interest is indisputable, and equally its inappropriateness for Government endowment

The proposed arrangement probably satisfies the wishes of no one concerned, but it has one paramount merit. The Government may accept it. It is very tempting to suggest possible developments. The editor of *Science Abstracts* would find his natural home in the library of the institution, and the scientific monographs for which we hope might follow. The profits of the Patent Office might conveniently pass through its accounts.

We must be thankful for what we can get, and if the argument of economy of administration will persuade the Government to endow an establishment to do their own necessary work, with permission to spend money on physical research, we have gained much.

INDUSTRIAL BANKS AND ELECTRICAL DEVELOPMENTS ON THE CONTINENT OF EUROPE.

In a recent issue * we published a letter from Mr. John S. Raworth, dealing with the aid given by German and Swiss banking houses to the developments of the electrical industry in Europe and other parts of the world.

An extraordinary number of concessions for lighting, tramway, or power purposes, are now being exploited in Italy, Spain, and South America, with the support of German capital. No benefits from this rapid development abroad will accrue to the capital invested in British electrical industries or to British labour, for the simple reason that the orders for machinery and equipments will naturally go to the country which is financing these new undertakings—Germany.

As an example of the operations of these banks, we give below an abstract of the report for the year 1897-98, of the "Bank für Elektrische Unternehmungen," of Zurich, published in the *Elektrotechnische Zeitschrift* for September 15th. This report states that the electrical industry during the past year had shown extraordinary activity in all its branches, and that the rate of expansion is likely to continue. The bank had promoted a number of new undertakings in Spain and Italy, under the form of syndicates, and had been obliged to call up the remaining half of its capital in order to finance these new ventures. The gross profit for the past year had amounted to £74,160, as against £52,520 in the preceding year, and the net profits were £42,400, as against £30,480.

This profit, with the balance from the preceding year, will permit of a dividend of 5 per cent. upon the share capital of £866,800. None of the undertakings in which the bank has become interested in the past year have yet commenced operations, but most of these will be earning profit during the current year. The assets of the bank are now increased to £1,710,000, and are distributed as follows:—Share capital in subsidiary companies, £441,600; debentures and loans, £634,000; reserves, £629,600.

* Electrical Review, September 9th.

The undertakings in which the bank is interested are the following:—

1. Officine Elettriche Genovesi in Genua. Financial interest, £272,000. This company has been formed to supply 40,000 incandescent lights and power for traction purposes in Genoa. The plant was completed in 1897.

2. Societa Genovese di Elettricita in Genua. Financial interest, £26,840. This company transferred its Genoa concession to the preceding one, and now confines its operations to Sampierdarena only. In 1897 it earned 5 per cent.

3. Ferrovia Elettriche e Funiculari in Genua. Financial interest, £254,840. This company possesses a concession extending over 24 kilometres tramlines and 1½ kilometres cable lines. 19·7 kilometres of this is now in operation. This company has paid 5 per cent.

4. Societa dei Tramways Orientali in Genua. Financial interest, £96,760. 12·3 kilometres out of a total concession of 25 kilometres are now in operation. During the first half of the present year the receipts have been satisfactory.

5. Unione Italiana Tramways Elettriche in Genua. Financial interest, £244,400. The lines owned by this company have been worked by horses up to the present date, but electric traction is now in course of application to these lines.

6. Sevilla Tramways Company, Limited, London. Financial interest, £65,200. This company paid 5 per cent. in 1897, though worked by horse traction. The necessary electrical equipment is now being installed.

7. Compania Sevillana de Electricidad in Sevilla. Financial interest, £65,200. This company did not pay any dividend in 1897, the surplus profit having been used to build up a depreciation fund.

8. Compania Barcelonese de Electricidad in Barcelona. Financial interest, £180,520. This company only commenced operations in 1898. Owing to the increasing demand for light and power, the generating machinery already requires duplication.

9. Compania Vizcaina de Electricidad in Bilbao. Financial interest, £71,360. This company paid 3 per cent. dividend as the result of its first year's operations.

10. Deutsch Uberseeische Elektricitäts Gesellschaft, Berlin. Financial interest = 3·3 per cent. total capital. This company is engaged in exploiting electric lighting concessions in Buenos Ayres.

11. Elektrische Unternehmungen in Santiago in Chili. Financial interest = 2 per cent. of total capital.

This bank appears to be fulfilling for Italy, Spain, and South America, the *rôle* of the British Electric Traction Company in this country. The noteworthy fact, however, is, that while most electrical engineers in this country are busily engaged in exploiting the concessions within its borders—in many cases with the aid of American generating plant or rolling stock—the ever-active Teuton is not only finding the capital and energy necessary for developments within the limits of the German Empire, but is obtaining the controlling interest in electrical undertakings in every quarter of the world. Why cannot some of our leading financial houses show similar enterprise to that exhibited by these foreign banks?

Telephonic Relays.

The New York *Electrical Engineer* of September 8th, contains an account of a telephonic relay recently patented by Mr. J. S. Stone, of Boston, Mass. The idea of a telephonic relay has occurred to many telegraphists, and such an appliance has been tried many times. Shorn of its details, Mr. Stone's patent only describes a telephonic receiver, to the diaphragm of which is attached the diaphragm of a Hunning's transmitter, so that the two diaphragms move in unison, and currents received in the telephonic receiver may be repeated onwards by the Hunning's transmitter. It has, however, long since been generally understood that the vibration of the diaphragm of a telephonic transmitter is much greater than that of the diaphragm of the receiver. By resting the tips of the fingers lightly on the diaphragm of a telephonic transmitter, the vibrations of the diaphragm can be felt when it is spoken against. The vibrations of the receiver's diaphragm are, however, quite imperceptible. The article in the *Electrical Engineer* gives no account of the conditions under which Mr. Stone's relay has been tried, indeed, it leaves a doubt as to whether it has been tried at all, and it would be interesting to know whether Mr. Stone has invented a workable telephonic relay or has merely patented a crude idea.

THE REACTION CARBON BRUSH-HOLDER.

The advance of the direct current dynamo to the position it now holds is due in a very great measure to the careful working out of brush gear and commutator details. Such points, for example, as the arranging of the mica and metal of the segments so that they shall wear down equally, and the introduction of the reaction carbon brush-holder. Surprise has often been expressed as to why manufacturers do not adopt the special methods of winding, auxiliary poles, and other dodges which have from time to time been proposed to minimise supposed sparking troubles. The fact is, that owing to the introduction of the high resistance carbon brush, the better understanding of commutation, and the mass of accurate data which large firms have now available, there are no sparking troubles to minimise.

Practically all machines built abroad are now fitted with carbon brushes, and it has been thoroughly proved in practice that any increased cost of the commutator is much more than covered by the advantages obtained. The only limit to the output of modern machines is the thermal or heat limit.

Those of our readers who perused Mr. E. Kilburn Scott's articles on "Carbon Brush-holders," in our issues of April 22nd and May 6th, 1898, will find some further interesting details on the subject in the *Electrical World*, of New York, for July 23rd, 1898.

The various forms of the reaction (Baylis) brush as made by the leading firms in the States are there fully described, and we give fig. 1 herewith, showing the form of holder made by the Eddy Manufacturing Company.

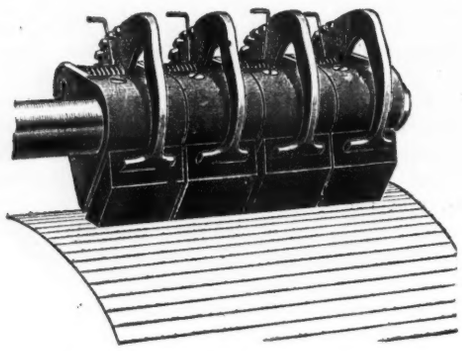


Fig. 1

As will be seen a finger casting presses against the back end of the carbon block and this in turn bears against a flat surface of the holder (it should be noticed that only this one surface need necessarily be finished). The finger is forced downward by a coiled spring, the free end of which can be hitched into any one of a number of notches in the segment part of the finger casting. The finger is cranked somewhat, bringing the segmental rear end to one side, and thus allowing the maximum amount of room for the spring.

The advantages claimed for the reaction brush are:—

(*a*) The freedom of the brush to follow any irregularities on the surface of the commutator by moving backwards or forwards in a straight line, instead of oscillating about an axis.

(*b*) The inertia of the brush and other moving parts is small, and thus the carbon block is able to promptly follow any unevenness of the commutator.

(*c*) There is no chattering.

(*d*) The metal part of the holder can be brought close up to the surface of the commutator, as it, the holder, is always stationary, no margin has to be allowed for wear.

(*e*) The distance through which the current must travel through the carbon is so very short, that a higher density per square inch can be allowed, giving a smaller commutator.

(*f*) The carbon block can be easily removed at any time, even when the machine is running, and when replaced no adjustment is lost, the carbon settling back exactly into its place.

(*g*) The carbons may be in actual contact sideways, and thus the entire face of the commutator can be made use of.

(*h*) The holder castings need not butt against each other, and two standard sizes will serve for machines ranging in capacity from 2 kilowatts to 2,000 kilowatts.

(*i*) A remarkably light pressure against the commutator is all that is required, and on this account the wear is small, and fine grain carbons may be used to advantage.

This question of pressure is an important one, for if there is too much of it, the carbon, if at all fine, grinds away very quickly. This is especially to be guarded against in high voltage machines, the large amount of dust which is made having a tendency to make the brushes flash round. Hard coarse-grained high resistance carbons are therefore necessary for high voltages.

The Le Carbone Company recommend the following pressures:—

Quality.	Pressure on commutator.
Special	100 grammes per sq. cm. of contact surface.
Electro-graphitic ...	50 grammes per sq. cm. of contact surface.

The *special* quality is a fine close-grained carbon which will carry currents up to 10 amperes per square centimetre of contact surface. The *electro-graphitic* is a carbon which has been transformed into graphite by being submitted to the temperature of the electric arc in the Girard and Street process. The molecules are, so to speak, soldered together by condensed carbon vapours, and they form a mass similar to a substance heated to melting point.

The conductivity of brushes made in this way is said to be four to five times greater than that of special quality brushes, and they will take currents at the rate of 20 amperes per square centimetre.

A good deal of thought and experimenting has had to be exercised in arriving at the results obtained, as the matter is not so simple as it looks. Lampblack, for example, makes a smooth and homogeneous brush, but it presents the disadvantages of wearing quickly and blackening the commutator. So called self-lubricating brushes in which plumbago enters have also this disadvantage. It has been proposed to use finely ground mica mixed with the carbon,

Table I.

Volume of the brush in cubic centimetres.	Price in Q. S. quality.	Price in E. G. quality.	Volume of the brush in cubic centimetres.	Price in Q. S. quality.	Price in E. G. quality.
	s. d.	s. d.		s. d.	s. d.
0·5	0 3½	0 4½	33	1 4	4 6
1	0 5½	0 7	34	1 4½	4 7½
2	0 6½	0 9	35	1 4½	4 9
3	0 7	0 11	36	1 4½	4 10½
4	0 7½	1 0½	37	1 5	5 0
5	0 8½	1 2	38	1 5½	5 1½
6	0 9	1 3½	39	1 5½	5 3
7	0 9	1 5	40	1 6	5 4
8	0 9½	1 6½	41	1 6½	5 5½
9	0 9½	1 7½	42	1 6½	5 7
10	0 9½	1 9	43	1 7	5 8½
11	0 9½	1 10½	44	1 7½	5 10
12	0 10	2 0	45	1 7½	5 11½
13	0 10	2 1½	46	1 8	6 0½
14	0 10½	2 3	47	1 8	6 2
15	0 10½	2 4½	48	1 8½	6 3½
16	0 11	2 6	49	1 8½	6 4½
17	0 11	2 7½	50	1 9	6 6
18	0 11½	2 9	51	1 9½	6 7½
19	0 11½	2 10	52	1 9½	6 8½
20	1 0	2 11	53	1 10	6 10
21	1 0½	3 0½	54	1 10½	6 11½
22	1 1½	3 2	55	1 10½	7 0½
23	1 1	3 3½	56	1 10½	7 2
24	1 1½	3 5	57	1 11	7 2½
25	1 1½	3 6½	58	1 11½	7 3½
26	1 2	3 8	59	1 11½	7 4½
27	1 2	3 9½	60	2 0	7 6
28	1 2½	3 11	61	2 1	7 8
29	1 2½	4 0	62	2 1½	7 10
30	1 3	4 1½	63	2 2½	8 0
31	1 3½	4 3	64	2 3	8 1½
32	1 3½	4 4½	65	2 3½	8 3

but any lubrication which this would give would probably be more than counterbalanced by the lessened conductivity.

It has been observed that series constant current arc lighters when fitted with carbon brushes do not readily excite or pick up. This is evidently due to the small area of the brush surface and consequent bad contact. The fault has been met by placing strips of copper under the brush and temporarily short-circuiting the carbon, so to speak, but the point is one on which further information is desirable.

The prices of carbon brushes vary from 7d. to 1s. per cubic centimetre, and the extra charged for coppering generally runs about 25 per cent. on the cost of the brush. Owing to the good results obtained from well-designed holders there is a tendency to dispense with coppering, as it is somewhat of a nuisance to keep stripping the metal away from the end of the brush.

Table I. gives the prices of brushes supplied by the Le Carbone Company, and Table II. gives the prices (in dollars)

TABLE II.

	1″	1½″	2″	⅔″	3″	3½″	4″	4½″	5″	5½″	6″	6½″	7″	7½″	8″
¼ × ½	·07	·09	·10	·12	14	·15	·16	18	·19	·20	·22	·24	·25	·27	28
¼ × ⅝	·08	10	·11	·13	·15	·17	18	20	·22	·24	·26	·27	·29	31	·33
¼ × ¾	·08	·10	13	·15	16	·18	21	22	24	·27	·29	31	33	·35	·37
¼ × ⅞	·09	·11	14	·16	·18	·21	·23	25	27	·30	·32	·34	37	·40	·42
¼ × 1	·10	·13	·15	·17	20	23	·25	28	30	·33	·36	·38	·41	·44	·46
¼ × 1⅛	·10	14	16	·18	24	24	27	30	33	·36	·39	·42	·45	·48	·50
¼ × 1¼	·11	·14	·17	20	23	27	30	33	36	·39	·43	·45	·48	52	55
¼ × 1⅜	·12	·15	18	22	·25	·27	·32	·36	39	·42	·45	48	52	56	60
¼ × 1½	·13	·16	18	23	·27	30	34	38	·42	·45	·49	53	·56	60	64
¼ × ⅝	·13	·17	·21	·25	·28	33	37	41	45	·49	·52	·56	60	·64	·68
¼ × 1⅝	·14	·18	·22	·26	·30	·34	39	43	·47	·51	·55	·60	64	68	72
¼ × 1⅞	14	·18	·23	·28	32	37	41	45	50	·55	·59	·64	68	·73	·77
¼ × 2	15	·19	24	·29	·33	39	43	48	53	·58	·62	·67	·72	·77	·82
¼ × 2⅛	·15	·20	·26	30	·36	40	45	51	·56	·61	·65	·70	·76	·81	·86
¼ × 2¼	16	21	·27	32	·37	43	48	53	59	·64	69	74	79	·85	90
¼ × 2⅜	·16	·22	·28	·33	39	44	50	56	61	·67	·72	·78	·83	·89	·94
¼ × 2½	·17	·23	·29	35	·41	46	52	59	63	70	·76	·82	·88	·93	·99
¼ × 2⅝	18	·24	30	37	·43	48	55	61	67	73	·79	·85	91	·97	1·03
¼ × 2¾	18	25	·31	38	·44	50	57	63	·70	·76	·82	·89	95	1·01	1·08
¼ × 2⅞	·19	26	32	39	·46	52	·59	66	73	·79	·86	92	·99	1·05	1·12
¼ × 3	·20	27	33	41	·48	55	61	68	76	·82	·89	·95	1·03	1·10	1·17
¼ × 3⅛	21	·28	·35	42	·49	56	64	71	78	·85	·92	1·00	1·07	1·14	1·21
¼ × 3¼	24	·29	·37	·44	51	59	66	73	81	·88	·95	1·03	1·11	1·18	1·26
¼ × 3⅜	22	·30	38	·45	·53	60	68	76	·83	·91	·99	1·07	1·15	1·23	1·31
¼ × 3½	·23	·30	39	46	·55	62	70	78	·86	·94	1·03	1·11	1·19	1·27	1·36
¼ × 3⅝	·23	·31	·40	·48	·56	·64	73	81	·89	·97	1·06	1·14	1·23	1·31	1·39
¼ × 3¾	·24	·32	·41	·50	·58	·66	75	83	·92	1·01	1·09	1·18	1·27	1·35	1·43
¼ × 3⅞	·24	·33	·42	·51	·60	·68	·77	86	95	1·04	1·13	1·22	1·30	1·39	1·48
¼ × 4	·25	·34	43	·52	61	70	79	89	·98	1·07	1·16	1·25	1·34	1·43	1·52

Add 5% for ⅜″ thick. Add 20% for ⅝″ thick.
" 10% " ½″ " " 25% " ¾″ "
" 15% " ⅝″ " " 30% " 1″ "

of the Partridge self-lubricating brush which has been very extensively used for tramway and general motor work in the United States. This brush it may be mentioned is of pure plumbago.

It was a fortunate thing for the electrical industry that Prof. Forbes did not pursue his provisional patent for carbon brushes, and thus create another of those monopolies which may for a time be very nice for the interested individuals, but which hinders real progress.

NEW UNIVERSAL TERMINAL CONNECTOR FOR RHEOPHORES.*

THIS little apparatus is intended to obviate a grave inconvenience connected with the rheophores of the various electric machines or batteries employed in medicine; when, from the effect of accident or oxidation, the flexible cord becomes broken, it is rather difficult and always very tedious to make a join with the terminal connector which is often soldered to the bunch of fine metallic wires that constitutes the rheophore; moreover, this operation requires a certain time, even when merely temporary. With the special connector designed by Dr. Armaignac several years ago, and made by the firm of Saint Martin, of Bordeaux, this join is made in a few seconds, it is satisfactory and very firm, and the operation can, in an emergency, be performed without the aid of any instrument.

This connector consists of two parts, screwed one into the other. The part, A B, or the socket, is hollowed out longitudinally into a cylindrical bore which is twice as large at the end as in the middle. The end, B, of this hollow is cut with a screw thread so as to receive the head of the connector properly so called, C D, fig. 2., while the extremity, A, is shaped somewhat into a funnel, in order to allow the cable, *e e'*, to pass freely.

In order to fix the cord on to the connector, we begin by unscrewing the part, C D, then the cord is introduced into the end, A, of the socket, the sheaf of wires having been denuded of its envelope of silk or cotton along a certain length. When the cord projects some centimetres beyond the connector (fig. 1) a knot is made in the middle of the

FIG. 1

denuded part, *f f'*, or it is merely doubled back or curled up by means of pincers so as to form a head or lump, which will lodge in the bottom part of the large cylindrical space of the socket when the wire, *e e'*, is pulled back. This protuberance cannot pass through the narrowed middle part of the socket, and, when the connector, C D, is screwed up tightly, a compression will be produced that will bring about perfect contact between the sheaf of wires of the cord and the connector

FIG. 2.

itself. The greater this compression the closer will be the adherence of the wires to the connector, and consequently the firmer will be the join. To effect this satisfactorily and to prevent the sheath of the cord becoming loosened from the conical part of the socket, it will be sufficient to wind a few spirals of wire or silk round the part of the cable immediately below the denuded portion.

* *L'Industrie Electrique.*

PRESTON'S INVESTIGATIONS ON THE ZEEMAN EFFECT.

(*Concluded from page* 515.)

IN the course of his observations, Mr. Preston found that if we take the case of a single substance, say, cadmium or zinc, the most casual observation is sufficient to show that the effect produced varies considerably for the different spectral lines; for while some lines are clearly separated into distinct triplets, others are not so resolved, but show on the photographic plate as "quartets" or "doublets," the source being viewed *across* the lines of force, *i.e.*, while some lines show as sharp triplets, others (if we wish to express it so) show as triplets in which the middle line is replaced by two fainter lines, while others appear to have lost the middle line completely. Further, some lines on the same plate, that is, photographed under exactly the same conditions, show only a very small broadening; but in no case has he found a line which could with certainty be said to be absolutely unaffected by the magnetic field.

Thus, while some lines are largely affected, others (and these may be of not very different wave-length) are scarcely affected at all. With a stronger magnetic field, however, he hopes to resolve these latter, and so obtain the data necessary to a full comparison of the effects produced on all the spectral lines, and so be able to attack the problem of throwing

the lines into groups and series, periodic or otherwise, subject to some general law. Although the photographs already obtained throw out some hints as to the direction in which such a law is to be looked for, yet nothing can be sufficiently decided till a careful survey has been made and every line resolved and measured.

Fig. 2 has been reproduced from a portion of a negative showing the lines of cadmium and zinc taken simultaneously. For this purpose an electric spark from an induction coil was passed between two electrodes, one of cadmium and one of zinc, so that the lines of the two metals as affected by the magnetic field were photographed under precisely the same conditions. The lines shown are the blue (4800) and the violet (4678) lines of cadmium together with the adjacent lines (4811, 4722, and 4680) of zinc. The plate shows the various lines unaffected, that is, when the magnet is unexcited, as well as the effects produced by the magnetic field. The bottom row, A A, shows all the lines converted into doublets when the source of light is viewed *along* the lines of force. The next row, B B, shows the lines unaffected, *i.e.*, with no magnetic field.

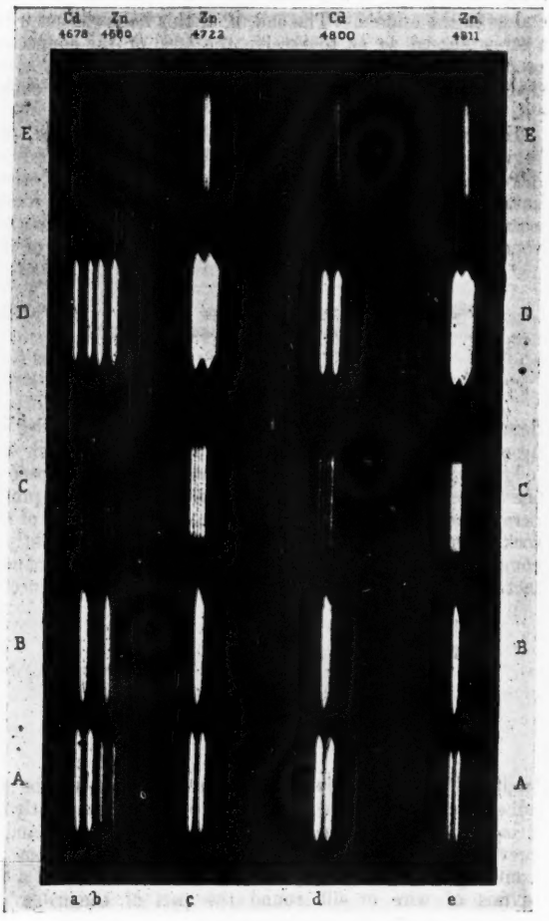


FIG. 2.

The next row, C C, shows the appearance presented when the source is viewed across the lines of force, and it may be here observed that while the line 4678 of cadmium and the the adjacent line 4680 of zinc are both converted into triplets, the line 4722 of zinc and the celebrated blue cadmium line 4800 are not so resolved (in appearance), but show as a species of quartets in which most of the light is concentrated in the side lines. Finally, the line 4811 of zinc shows as nothing very definite, but may in this picture be described as a hazy doublet. It is to be remarked, however, that many lines show as perfectly distinct doublets when viewed across the lines of force, doublets which are scarcely rendered any clearer by the interposition of a nicol.

The two rows at the top of the plate show the polarisation of the affected lines. In these a nicol has been inserted in the path of the beam of light. In the top row, E E, the nicol is placed with its principal plane parallel to the lines of force, and in the other row, D D, with its principal plane at right angles to the lines of force. The polarisation of the constituents is thus shown to be complete and in two rectangular planes.

The foregoing are the appearances presented on the photographic plate. In addition to these there are two other modifications depending on a fineness of detail not as yet recorded on the photographic plate, but which presents itself with great distinctness to the naked eye when lines are viewed through a well focussed eyepiece. One of these modifications occurs in the case of lines which photograph as doublets when the source of light is viewed across the lines of force, and may be described by saying that the affected line is a modified triplet in which the central line is absent, and in which at the same time each of the side lines is reversed. Thus the appearance presented to the eye is that of two pairs of lines rather than a doublet or triplet. The other modification of note is that in which each constituent of the triplet shows as a pair of lines, or, in other words, the whole appears not as a triplet but as a sextet of five equally spaced, well marked, and sharp lines.

All the modifications so far observed, when the source of light is viewed *across* the lines of force, are illustrated by the accompanying fig. 3. Thus, in 1, we have the

FIG. 3.

normal triplet, such as is presented by the violet line of cadmium, 4678, and the vast majority of other lines. Then we have in 2 the weak middled quartet in which nearly all the light is concentrated in the two side lines, and finally, in 5, the sextet or three pairs of equally spaced sharp lines.

It is interesting to remark that the two D-lines of sodium do not show as triplets in the magnetic field. Steady lines can only be obtained sharp and fairly steady when the sodium salt is contained in small quantity in the solution, and under these circumstances one of the sodium lines, D_2, shows as a sextet (5, fig. 3) of fine, sharp, equally-spaced lines, of which the two border lines are somewhat nebulous on their outside edge. The other line, D_1, is of the double doublet type (4, fig. 3), and shows as two pairs of sharp lines.

Mr. Preston considers that these deviations from the theoretical triplet can be accounted for by the reversal of the lines caused by the vapour surrounding the incandescent elements. He also points out that all the assumptions of the mathematical theory may not be fulfilled in nature. For, in order that a spectral line should exhibit itself as a characteristic triplet under the influence of the magnetic field, it is necessary that the freedom of vibration should be equal in all directions, and in this case the intensity of each rectangular component will be the same. Hence the middle line of the triplet will contain as much light as the two side lines taken together. If, however, the vibrations are not equally free in all directions the foregoing result will not hold, and it becomes possible to have a triplet with a weak middle line or without a middle line, in which case it shows as a doublet. For example, if the vibration is restricted to one plane, and if this plane sets itself at right angles to the lines of magnetic force under the influence of the magnetic field, then the component of the vibration in the direction of the lines of force will be zero, and the middle line will vanish from the triplet. If, on the other hand, the complete vibration should set itself parallel to the lines of force, then the side lines of the triplet would vanish, or, in other words, the spectral line would be unaffected by the magnetic field. It is clear, therefore, that the study of the way in which the spectral lines are affected by the magnetic field is likely to throw light on the character of the molecular vibrations.

The magnetic substances, iron and nickel, might be

expected to show some tendency to set their molecular orbits at right angles to the magnetic lines of force, and, therefore, to show doublets instead of triplets; but Preston found that such was not the case. The majority of the iron lines are resolved into distinct triplets, showing that these vibrations possess complete freedom in the magnetic field (at the temperature of the spark). But some of the lines do show as distinct doublets, and the appearance of these doublets is not that usually associated with a reversal. In addition, there are other lines in the spectrum of iron which were scarcely affected, if at all, by the magnetic field.

Gases could not be made to show distinct triplets, but the triplication could be proved to exist by the use of the nicol.

According to theory, the separation of the side lines of a triplet should be proportional to the square of the wave length, but the measurements made by Preston did not confirm this theoretical deduction. He thinks, however, that the lines of any one substance may be thrown into groups for each of which the law holds good. Each of these groups might then be attributed to the motion of a single ion.

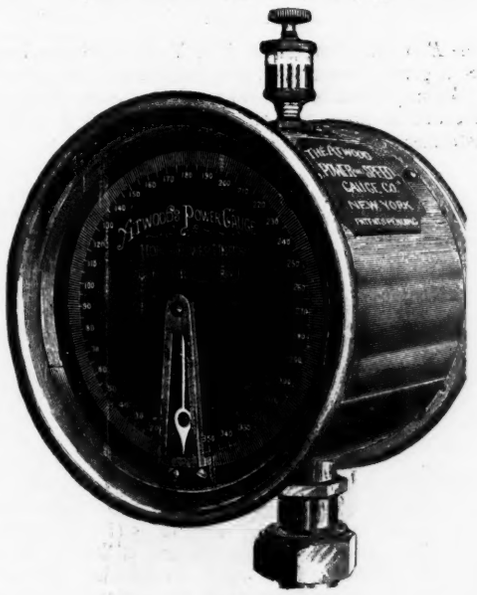
These deviations from theory are likely to prove very instructive, and when their true explanation is arrived at the theory will probably have been considerably modified. The present theory of the atom with a particle of electricity perched on its back, appears almost absurd in its crudity; the wonder is that it is capable of giving a rational explanation of so much.

A DIRECT-READING MEAN EFFECTIVE PRESSURE INDICATOR AND POWER GAUGE FOR ENGINES.*

By G. F. ATWOOD.

THE function of this novel instrument is to continuously measure and give a direct visual indication of the mean effective pressure applied to the piston of an engine, or the average pressure of a series of intermittent pulses, such as those occurring in all reciprocating motors, using steam, air, gas, water, &c., without the necessity of taking indicator diagrams and computing the result therefrom.

It is, therefore, designed to fill the gap heretofore existing (in direct-reading instruments) between the boiler room and



THE ATWOOD POWER GAUGE.

the switchboard, and its utility is obviously to provide data whereby the plant may be operated with the intelligent management and care that follows when a full knowledge is obtained of what is taking place in every branch of the system, and, therefore, the maximum efficiency consistent with the apparatus in use may be maintained.

In the accompanying engravings, fig. 1 is a front view of the instrument; fig. 2 relates to the dials of the most recent instruments, and will be explained hereinafter.

It will be noted that three-way cocks are inserted at the indicator outlets of the engine cylinders, to which the power gauge and steam indicator are connected, and which permit either instrument to be used separately, and also enable measurement to be taken of work done in either end of the cylinder with the power gauge, as described later.

A special reducing motion, not shown in the engravings, connects the instrument with the crosshead, which, together with the piping, requires the instrument to be permanently attached, and it is well adapted for continuous service.

The principle upon which the instrument works, broadly speaking, is the measurement of the pressure of steam, or other working fluid, by the velocity of a steam turbine instead of the usual method of balancing its static pressure against a spring, and the mean pressure of a series of impulses is measured through the medium of a steam turbine having a sufficient moment of inertia to render its velocity substantially constant for successive impulses of the motor agent, when those impulses are of equal value.

An instrument constructed to work upon these principles consists of a dynamometer, tachometer, or even a small dynamo, adapted to be driven by a turbine motor; this motor in turn being driven by the steam from the cylinder of the engine through two pairs of nozzles, each pair set at such angles as to oppose each other, and connected to the opposite end of the cylinder by piping.

The arrangement of nozzles is such, that a minute portion of the steam driving the piston forward passes through what may be termed a + nozzle, and acts to drive the turbine in a clockwise direction, while the exhaust steam in the opposite end of the cylinder, which is acting to retard the motion of the piston, is directed through a — nozzle against the turbine in such a manner, that it retards the forward motion of the wheel, and thus its velocity is the resultant of the two forces acting in opposing directions.

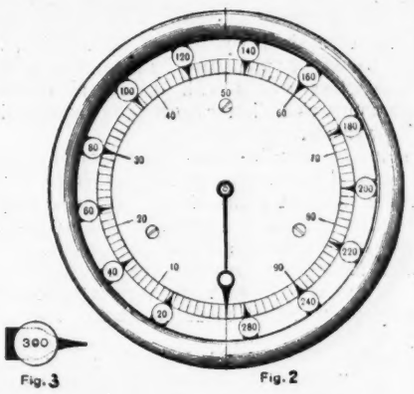


Fig. 2

Fig. 3

Fig. 4

When the piston has completed its stroke, the second pair of nozzles are put in service, and the first pair shut off through a simple mechanical connection to the crosshead, and the same action takes place during the return stroke, each pair being alternately opened and closed at the termini of the stroke, and thus keeping the turbine running in a continuous direction.

This arrangement of nozzles is for the purpose of subtracting the back pressure and compression which are negative quantities, while the inertia of the turbine takes care of the varying pressure during the stroke, so that its velocity becomes a measure of the mean effective pressure.

The indicating mechanism acts as a load upon the motor and prevents undue acceleration. It consists of a fan attached directly to the shaft of the turbine, and adapted to drive a second fan mounted upon a delicately-pivoted shaft

* New York *Electrical Engineer*.

and having a retractile spring and an indicating hand or pointer.

As the first fan is rotated by the turbine it tends to rotate the second fan by the current of air set in motion, and the angular deflection is proportional to the velocity of the turbine, which in turn is a measure of the M.E.P.

The dial, as shown in fig. 2, has an inner scale calibrated to read M.E.P. units, and permits the use of the instrument to measure intermittent pressures, while the outer scale is made up of adjustable indices having a numeral surface upon which figures representing horse-power are marked, figs. 3 and 4.

The indices are slipped over the periphery of the dial, and maintain their position by friction. They are adjusted according to the engine data to their proper positions, by the engineer, by simple calculations from the M.E.P. scale. For instance, suppose an engine having a piston with an area of 176 square inches running at a velocity of 500 feet per minute, 30 lbs. M.E.P. would equal 80 H.P., and the adjustable index marked "80" would be set opposite 30 of the M.E.P. scale, and this operation continued with the remaining indices with the result of forming a horse-power scale for rough and ready readings. Of course, this applies to governing engines only, as this scale is based on constant speed, and for variable speed engines the M.E.P. scale only is used.

The practical application of this instrument has demonstrated the following points of utility:—By its use the efficiency of an electric power plant may be more readily and accurately determined than heretofore—in fact, it is practically under observation at all times, and where "logs" are kept a more complete record of the working of the plant is obtained, embracing the coal and water consumption, with the energy delivered to the engines and the output of the dynamos, than was heretofore possible, whereby improvements in the plant, quality of coal, &c., as well as the depreciation may be readily noted and compared.

This instrument also furnishes, through visual indications, a variety of other useful data, heretofore only obtainable through the most difficult measurements; in fact, so difficult that they are rarely taken; as, for instance, the division of work done between two or more cylinders of engines driving a common and varying load; also the division of work done in either end of a single cylinder of each engine, a feature which will be readily appreciated by those who have tried to obtain satisfactory results with the ingenious devices for taking simultaneous indicator cards upon engines with "see-sawing" governors.

There are innumerable cases where two or more engines coupled together are working at uneconomical points, due to the fact that the work is not divided proportionately, and in these cases, as well as in compound and triple-expansion engines, both condensing and non-condensing, this instrument offers means for observing the distribution of work done in the several cylinders under various loads, and adjustments may be therefore made to obtain the maximum economy.

Other useful data obtainable from the power gauge is the "friction load," this being observed every time the engine is started, and any friction exceeding the normal amount is noted; also the energy required to drive any particular machine or load when proper means are taken for its mechanical separation from the remainder; as, for instance, with arc light machines the energy required to drive each particular machine is readily noted on the power gauge on the engine, when that machine is put in circuit.

These features, together with the fact that the instruments are adapted for continuous service, and do not require an expert to manipulate them, renders them an extremely important adjunct to an engine equipment.

Instruments are in service that have been running continuously for 18 months, and show an error of less than 1 per cent., as compared with indicator diagrams.

LIGHT RAILWAYS IN GREAT BRITAIN.

A SHORT article in *Cassier's Magazine*, by Mr. C. E. Spagnoletti, on "Light Railways in Great Britain," cannot be held to be much else than a series of platitudes interlarded with a very little modern history. Thus we are told that permanent way and structures must be strong enough for the heaviest traffic likely to come upon them.

"When a line runs along a public way, a continuous barrier may be necessary." Now this is quite opposed to the idea of the light railway, and so also is the suggestion as to standard gauge. If a light railway is to carry ordinary gauge stock, it will begin to cost a good deal more than can be afforded by the very districts where light railways are needed.

Where traffic is large, the light line might, perhaps, be made of standard gauge, but the cost of transfer at a break of gauge is often merely nominal, and would be carried out by men who otherwise would be simply loafing about the station, yet who are obliged to be employed even for an amount of work they can get through in an hour or two per day. The author seems quite to have missed the basal idea of the light railway. He speaks of speeds of 25 miles per hour, 30 ton locomotives, and so on, all of which would necessitate costly signals and expensive details of track. The ideal light railway is one which carries goods where hitherto expensive cartage has been necessary, and the construction of which must be minimised in cost to be covered by a very small traffic. We know of one on which only two trains of mixed traffic run each way daily. Yet the author would have such lines of standard gauge, which in Ireland would mean 5 feet; whereas it would be the making of the Irish lines if they were all reduced to 3 feet 6 inches gauge. We fear Mr. Spagnoletti has obtained a very poor grasp of the light railways problem. The light railway, in the first instance, will carry goods which have hitherto been carted, will carry people to market towns who have hitherto either tediously walked or driven in vehicles at the cost of putting up at an inn, and all which that implies. They are not wanted for rapid travelling, for already, at only eight miles per hour they may easily save passengers a couple of hours in a short journey, not to mention fatigue and absence from other duties, and power to make more frequent journeys, and generally an ability to conduct business at less trouble. For all this in a poor district very simple means are alone needed.

A NEW TRANSFORMER.

IN the *Electrical Engineer*, of New York, for September 8th, 1898, is given a description of a transformer constructed by the Moloney Electric Company, of St. Louis, Mo., which lays claim to great perfection. Figs. 1 and 2 show this transformer with and without cover.

FIG. 1.

The objects aimed at in the construction of this transformer have been maximum all-day efficiency and close regulation. Copper loss is reduced by lessening the resistance of the coils and using wire comparatively large for

the current it has to carry. Leakage is practically nullified by the peculiar construction of the core and windings.

Alternating currents circulating in the coils, the wires are attracted and repelled. This ceaseless attraction and repulsion soon pulverises the insulation, and some of the turns of the coil come in contact; injury to the apparatus follows where the coils are wound loosely with a packing of some insulating material. This has been remedied (1) by compressing the cores under very high pressure, which is made possible by their construction; (2) by winding the

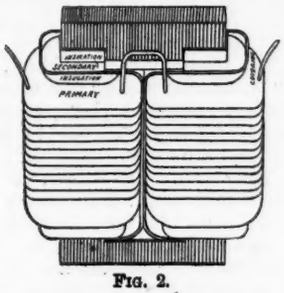


Fig. 2.

wire on the coil under very high tension; (3) by using only the very best insulation, as their patent insulation is considered to be. The transformer has been so constructed that most of the waste energy is lost on the outer surface, whence the heat is easily dispelled through the ventilating slots. This construction has the result that there is comparatively little increase in temperature even while the transformer is under full load.

The company construct the cores with iron, which they declare does not degenerate after 18 months' use. Fig. 3 gives curves of efficiency plotted from figures obtained from actual tests. Curve A shows the maximum

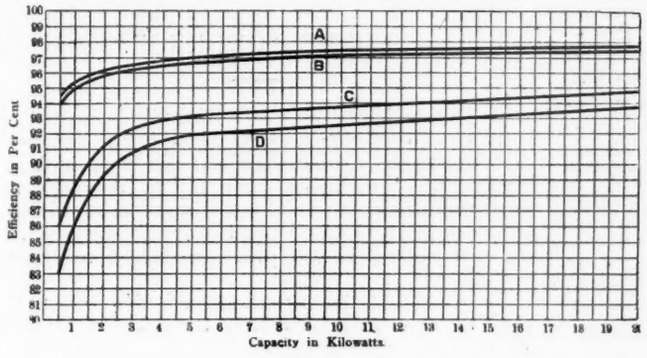


Fig. 3.

efficiency at 133 cycles; curve B shows the maximum efficiency at 60 cycles; curve C the all-day efficiency at 133 cycles; and curve D the all-day efficiency at 60 cycles.

MODERN TRANSFORMERS.

By W. G. RHODES, M.Sc.

One of the most important considerations in the construction and organisation of an alternating current installation is the choice of suitable transformers. Upon such a choice depends to a great extent the efficiency of the whole plant and the regulation of pressure on the consumers' premises. If the light load losses in a transformer are not kept as low as possible, the all-day efficiency is seriously affected; if the secondary resistance is too high and if there is appreciable magnetic leakage, the regulation may be so bad as to breed dissatisfaction amongst the consumers and consequent loss of custom. On this account it is not only advisable to have transformers possessing all the most modern improvements, but also to employ as few as possible consistent with the requirements of the area to be fed. It is, in fact, economical to replace large numbers of old type transformers by a few modern transformers having the same or greater aggregate capacity. This is well illustrated by the following cases:—

In a town in Massachusetts having a population of 56,000, an alternating current station was constructed a few years ago, and 57 small transformers having a total light capacity of 1,499 lights were installed. Quite recently these have been replaced by 18 modern transformers capable of supplying 1,624 lights. The total core loss of the old transformers was 5,866 watts; that of the new, only 1,348. This difference in losses gives a yearly saving of 39,578 kilowatt-hours, which may be valued at about £132. Thus neglecting all the advantages except the diminution of core losses, the cost of the change will be met in 1 year and 9 months. The light capacity of the plant is increased 9 per cent., while the total core loss is decreased by 77·5 per cent. Further, on account of the decreased core loss, 4,518 additional watts are available for sale, producing an additional income of £169 at the present rate.

In another case 40 new type transformers replaced 53 old ones. The total capacity of the old ones was 1,135 lights, of the new 1,070. The core loss of the old transformers was 4,845 watts, and of the new 1,343 watts. This gives an annual saving of 30,678 kilowatt-hours, which will cover the expense of the change in 2 years and 9 months.

As regards regulation, we cannot too strongly urge the necessity of keeping it under full control. It is not necessary to point out how injurious to incandescent lamps is undue variation of voltage. If lamps are over-run, their life is considerably shortened, and frequent renewals are the inevitable consequence. This, together with the bad light which results, is bound to beget the distrust and disgust of the consumer. It is a fact frequently not realised that a change of 1 per cent. in the voltage causes a change of about 7 per cent. in the candle-power of an incandescent lamp. A variation of 4 per cent. on either side of the normal voltage, that is, a total variation of 8 per cent., means over 50 per cent. change in the candle-power. It is a lamentable fact that such changes are only too frequent in alternating current plants, and it is more than probable that this is the chief reason why so many alternating current stations fail to produce a dividend.

Why should this bad regulation occur? It is not because alternating currents are not as capable as direct currents of feeding any given area. It is because the management of alternating currents is not sufficiently well understood, and their application is not manipulated with sufficient skill. The phenomena of alternating currents are much more difficult to understand than those of direct currents, and no one is competent to undertake the management of an alternating supply station whose acquaintance with the subject is entirely of a *practical* nature.

I do not wish to depreciate practical experience, far from it, but I do wish to emphasise the necessity of a sound theoretical training as well. A manager of an alternating supply station ought to understand thoroughly the causes of bad regulation and to fully appreciate the various remedies. Bad regulation may be due to poor transformers, to large wattless currents caused by motors, &c., and to various other causes. Each cause has its remedy, and if the proper one is applied good regulation will result. Theoretical training enables us to determine the causes and their remedies; practical experience tells how best to apply the remedy.

I may safely say that the question of regulation is the most important of all to the supply company. What is more aggravating and annoying to the consumer than to have his 8 C.P. lamps sometimes giving fully 12 C.P., and at other times barely 3 or 4 C.P., sometimes less than this. Yet, such is the case with many alternating current stations. The result is the consumers return to gas as being more reliable, the electric company lose its custom, or at any rate does not increase it. The electric supply committee grumbles because the plant does not pay, and the blame is laid on the alternating current. This is nonsense, sheer nonsense. The alternating current is all right if it is properly managed. It is the application and management which is at fault. The real reason why direct current stations are usually a

greater financial success than alternating current stations is because the application and management is simpler, and the regulation is more reliable. Make the regulation of an alternating current plant equally good, and the financial success will be greater, because often the losses in a direct current supply are greater than in an alternating current one. If potential wires are led from the centres of distribution to the generating station to give indications of the rise or fall of pressure, a competent man should be able to make an alternating current plant quite as reliable as is possible with continuous currents. Frequently it is an impossibility to attain the necessary high efficiency with continuous currents, and, having installed an alternating current plant, it is an admission of incompetency to allow it to be a failure.

THE INFLUENCE OF THE VARIATION IN SPECIFIC HEATS UPON THE THEORY OF THE GAS ENGINE.

By W. H. BOOTH.

The experiments, of which a brief abstract appeared in the Electrical Review, of September 30th, have a somewhat important bearing. The experiments indicate that at low temperatures the specific heat of various metals was considerably below the specific heat at higher temperatures. There is now sufficient evidence also that the specific heat of gases at high temperatures is greater than at low temperatures, and, as a rough generalisation, it may be assumed that elevation of temperature is accompanied in all instances by an increase of specific heat. Granting that such be the case, the importance of this in relation to the heat engine is very great. Especially so is this the case with the gas engine. The explanation of deferred combustion, hitherto usually ascribed to the dissociation of compound gases at high temperatures, has of late been held or at least allowed to be not altogether satisfactory, and there appears certainly very good reason on the side of those who argue that the deferred combustion, or as we should now perhaps say, the deferred pressure, is due not to any really deferred combination of the gases in the cylinder so much as to the large increase of their specific heats. For example, if a cylinder temperature of 4,000° is expected from an explosive mixture, and only 3,000° can be shown as being attained on the basis of the volumes present in the cylinder, the upholders of the theory of dissociation would have us to believe that at a temperature of 3,000° any further combination of the gases ceases to be possible, and further combination only occurs as the piston moves forward and the gases become subject to the cooling influences of expansion and of the cylinder walls, cooled by the unscientific water jacket. As soon as this occurs, and the temperature begins to fall below 3,000°, there occurs a continuation of combustion until the whole of the combustible gases are combined.

The action of the water jacket confuses any accurate reading of the gas engine diagram, and blinds any appearance of continued combustion if such really occurs. It is also open to us to argue that deferred combustion may be due to imperfect mixture, and this, too, without in any way committing ourselves to the stratification fad, which may be good enough for non-technical jurists. It is also open to us to argue that for the early part of the stroke, when the deferred combustion effects are the more marked, the expanding gases benefit from the heat radiated from the piston face which has just been exposed to the maximum temperature of explosion, and whose heating effect will be very considerable, and, perhaps, sufficient to partially outweigh the cooling effects of the jacket, then at its minimum of exposure to the gases. Apart from jacket effects, the deferred combustion theory would strictly give us a horizontal line at right angles to the explosion line of the indicator diagram. Upholders of the idea, of course, are open to promise that the want of horizontality is simply an effect of cooling, but they cannot surely argue it to be an effect of expansion, for the pressure ought to be practically maintained by the further combustion rendered possible by the very motion of the piston, which enables the combustion to go on at the maximum pressure, and which, as it does go on, should be able, apart from jacket effects, to maintain pressure in the cylinder up to the maximum until all gas is consumed.

On the other hand, those who may be inclined to advocate the theory of increased specific heat at high temperature, have a powerful argument in the shape of the best indicator diagrams, which do not tell much in favour of dissociation. These latter argue that combustion is at once complete and instantaneous, and that no delay occurs and no dissociation takes place, and they afford an explanation of the moderate pressure in the cylinder by claiming that at high temperatures the specific heat of a gas is so much greater than the accepted normal temperature coefficient, that heat is absorbed which would otherwise go in causing expansion and temperature, and, of course, higher pressure. Again, the opponents of the theory may point out that if this be so, the indicator card should show a line following the explosion line approximately horizontal. Of course, in each case this horizontal line should occur, but cannot do so because of the jacket effects. It may be that the truth lies between the two theories, that something of each action takes place in gas combustion. But it would appear desirable that some definite conclusion be reached and accepted by engineers, and a considerable step in this direction will have been taken when the variation of specific heat has been decided upon and accepted by the many as by the few, for, with the acceptance of this hypothesis, as it may still be called in face of the little attention accorded to it by engineers, there will follow the necessity of calculating the true possible maximum temperatures and pressures in the cylinders of gas engines on the basis of the true coefficient, and only then will it become possible to estimate or ascertain if and how much the older theory of dissociation has a bearing on the present occult phenomena of the gas engine.

CORRESPONDENCE.

"Some Motors and a Moral."

No question having been raised as to the accuracy of your comparison between the cost per unit at Messrs. Siemens Bros.' works—as given in Mr. Siemens's B.A. paper—and the cost at which public supply companies could deliver electricity, I should like to ask for information, and not by way of criticism, if your comparison is really a correct one.

You compare the 2d. per unit given by Mr. Siemens with the 1·79d. *total* cost per unit of the Bradford Electricity Works.

Now, in addition to costs of generation and distribution, Mr. Siemens's 2d. includes the whole of the costs in connection with the motors themselves, viz., repairs, stores, labour, 10 per cent. depreciation, and 5 per cent. interest. A further charge on the motive power is added, including 10 per cent. loss in transformation and 5 per cent. loss in distribution, bringing the total cost to 1·71d. per brake horse-power-hour at the motor spindle.

To compete with this, it occurs to me that a public supply company would not only have to generate electrical energy at less than this figure, but also to provide and fix the motors on the consumers' premises, and find all the attendance and stores necessary for their running and upkeep.

Your Bradford figures of 1·79d. per unit include nothing beyond the consumers' terminals.

When you state that "most public electricity works could *supply* electricity for motive power at a lower rate than it could be *produced* in a place possessing the skilled labour and the knowledge of economics of Messrs. Siemens Bros. and Co.'s works," it appears to me that you ought, for comparison, to take the cost of *generation* given by Mr. Siemens, viz., 1·287d. per B.T. unit, and not 2d., which includes far more than the expenses of generation.

F. Broadbent.

[The question of public *versus* private supply is in a most interesting stage at the present moment. The figures which we quoted, and to which our correspondent draws attention,

were taken quite at random. We will put our contention in another way: Mr. Siemens stated that if his works had been supplied with electricity at 1·8d. (the price charged in the Waldenburg district), the 1,200,000 B.T. units used in 1897 in Siemens Bros.' works at Charlton would have cost about £7,000 (against the £9,900 actually spent). Although this latter sum includes repairs and maintenance of motors, it would not account for nearly £3,000 difference. Hence, if Manchester can supply electricity for motive power purposes at 1·5d., Brighton at 1·5d., and Worcester at 1·5d., they can surely compete with private systems, even if one has to add to such costs the repairs, maintenance, and wages on motors. The cost of generation, 1·287d., given by Mr. Siemens, was at the station switchboard.—EDS. ELEC. REV.]

Gas Power for Marine Purposes.

I have seen in the REVIEW some articles about the applications of gas power to marine purposes. I am able to give some particulars, as I myself have succeeded in making constructions on explosive motors in this line, which fully realise all the demands on such an engine stated as necessary for this purpose in the REVIEW. With these engines one can start, "turn first in one direction, then slowly or quickly in the other, stop, move, wait, and move full speed ahead or astern, as the bell rings from the bridge, in such a manner and in such strict obedience to the movements of the reversing wheel, that they appear almost sensitive." Because the motor is directly connected to the propeller shaft, I need no electrical aid, no movable propeller blades, no couplings, or any such arrangements for obtaining these purposes. Up to date I have employed myself only about oil engines, but the applications can, of course, with the same result, easily be used on gas engines. I have already made and delivered several boats fitted with oil engines up to 8 H.P. under stipulation, that the engines are in possession of all the qualities mentioned, and they are all working quite satisfactorily, and are easily managed by their owners—private persons—and can be seen running every day. As the construction is quite reliable, the demand daily increases, and I am now about to manufacture motors for cargo and tug boats up to 150 H.P., but there is no difficulty in making engines of any size, as no power is wanted for handling the engine. A good thing, too, is that these motors are quite as cheap as other motors, because of the simplicity of the construction. I am willing to answer questions and give more particulars if required.

H. A. Bertheau.

Stockholm, *October 7th.*

LONDON COUNTY COUNCIL.

IT had been expected that an interesting debate would have taken place on Tuesday, at the usual meeting of the London County Council, on the subjects of telephony and electric traction, but this anticipation was in no way fulfilled.

THE TELEPHONE SERVICE.

In a lengthy report the Highways Committee recommended: "That the attention of the Postmaster-General be called to the expression of opinion in the report of the Select Committee on Telephones, that general, immediate, and effective competition by either the Post Office or the local authority is necessary, and that a really efficient Post Office service affords the best means for securing such competition; and that he be asked, whether, in view of that expression of opinion, it is his intention to take the necessary measures for establishing an efficient telephone system for the county of London."

This recommendation was adopted without any dissentients, although Col. Ford suggested that it would be as well to at once ask the Postmaster-General for a license.

In this connection it may be mentioned that the Highways Committee expressed the opinion that in the event of the Postmaster-General not being in a position, or not being disposed, to establish an efficient telephone system for London, independent of that of the National Telephone Company, it would still be open to the Council to renew its application for a license for London.

THE LONDON UNITED TRAMWAYS.

The Highways Committee reported having considered letters from Mr. J. C. Robinson, asking for the consent of the Council to the company applying to the Board of Trade for power to use the trolley system on certain of the lines of the London United Tramways Company. The details of this application were given in our last issue (*vide* the ELECTRICAL REVIEW, page 537). Commenting upon this request the Highways Committee said:—

"We are still of the opinion we have previously expressed that the overhead trolley system of electrical traction is unsuitable for the more crowded of the London thoroughfares; but we think that, as the company is desirous of making an experiment, and has offered to make concessions which will probably be of considerable benefit to the Council should the experiment ultimately prove successful, and has further expressed its willingness to adopt any other system which may be proved superior after further experience shall have been gained, the Council might in the circumstances give consent to the application being made by the company for authority to use the overhead trolley system of electrical traction, but so far only as regards that part of the company's tramways as is between the Askew Arms and the Uxbridge Road railway station. This consent, if given, will enable the company to apply to the Board of Trade to be allowed an opportunity for a full and satisfactory trial of the experiment upon a road quite at the outskirts of the county; and we consider that the Council should, for the present at any rate, not go further than this, and that, before giving consent to the use of the overhead system on the two routes (*b*) and (*c*) above indicated, the Council should ascertain whether the system proves successful in the Uxbridge Road, and is not a source of inconvenience."

The Committee accordingly recommended that Mr. Robinson should be informed that the Council would consent to an application being made to the Board of Trade by the company for authority to use the overhead trolley system of electric traction on the portion of the company's tramways between the Askew Arms and the Uxbridge Road railway station, a distance of 1 mile 3 furlongs and 3 chains; but that this consent would only be given on the company giving a written undertaking that the underground conduit system of electrical traction, or failing that, horse traction, should be used on the other tramways referred to in the letter, namely (1) from the Uxbridge Road railway station by Goldhawk Road to Young's Corner; and (2) from Young's Corner to Hammersmith Broadway.

Mr. J. W. Benn, chairman of the Highways Committee, asked for the permission of the Council to withdraw this report and recommendation, on the ground that the latter "did not quite reflect the views of the committee." The question would, he said, be brought up again next week. The Council consented to the withdrawal.

CENTRAL LONDON RAILWAY.

It was announced that the engineer of the Central London Railway Company had submitted, for the approval of the Council, amended plans for the company's stations at Oxford Circus, Tottenham Court Road, and the British Museum respectively. The company proposed that at each of the three stations there should be only one staircase from the station to the street level, instead of there being one each for up and down traffic respectively, as shown upon the approved plans. It was decided to approve the amended plans.

CITY AND SOUTH LONDON RAILWAY.

It was mentioned that application had been made on behalf of the City and South London Railway Company for sanction to the construction of a temporary shaft, in connection with the company's extension works, at the junction of Studley Road with Clapham Road. This is one of the two shafts which the company, by section 26 of its Act of 1890, is authorised to construct in the parish of Lambeth, subject to the approval of the Council and of the Vestry of Lambeth. The company desired to retain the shaft for nine months, and had undertaken to construct it so as to cause as little inconvenience as possible to the street traffic. The Vestry has already approved the works, and the Council also resolved to give consent.

OVERHEAD WIRES.

It was resolved to grant the application of Mr. G. Stegmann, asking for permission to erect an overhead wire in Wandsworth, exceeding in two places the length (115 yards) of unsupported span allowed by the Council's bye-laws, the length of such spans being 130 and 120 yards respectively. The applicant had submitted a plan showing the route along which the wire would be carried. Having regard to all the circumstances, and especially to the fact that the spans only slightly exceed the regulation length, the Council adopted the Highways Committee's recommendation approving of the application.

ARON METERS.

It was reported that the Board of Trade had given formal approval, under the Electric Lighting Acts and Orders, to the pattern and construction of the Aron meter, for the measurement of electrical energy when supplied on the constant potential continuous current system; and that the Board had also approved of the manner, set out in the notice, of fixing meters of that pattern and construction, and of connecting them with the service lines.

Wireless Telegraphy.—Some little time ago we referred to the part played by the Marconi system in despatching a record of the Kingstown Regatta to the *Dublin Daily Express*. The Wireless Telegraph Company now send us a copy of a pamphlet headed "Wireless Telegraphy and Journalism," in which are given particulars, accompanied by illustrations, of the experiment. Numerous articles are reprinted from the newspaper press.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week Ending Oct. 11th, 1897.	£	s.
Adelaide...	17	0
Alexandria. Teleg. mat.	400	0
" Teleph. mat.	159	0
Algiers	11	0
Amsterdam	155	0
Auckland	197	0
Beira	28	0
Bombay	69	0
Bordeaux	42	0
Bremen	36	0
Calcutta	92	0
Cape Town	948	0
Cologne	270	0
Colombo...	12	0
Demerara	16	0
Durban	1,255	0
East London	22	0
Fremantle	11	0
Hamburg	22	0
Madeira	50	0
Madras	28	0
Marseilles	246	0
Melbourne	238	0
New York	107	0
Ostend	26	0
Otago	44	0
Port Elizabeth	146	0
Rockhampton	131	0
St. Petersburg	56	0
" Teleg. mat.	32	0
Shanghai	10	0
" Teleph. mat.	60	0
Stockholm	450	0
" Teleg. mat....	80	0
Sydney	1,103	0
Wellington	127	0
" Teleg. mat.	2,476	0
Yokohama	275	0
Total	£9,134	0

Week Ending Oct. 11th, 1898.	£	s.
Amsterdam	53	0
Antwerp...	809	0
Auckland	85	0
Bangkok	9	0
Batavia	6	0
Boulogne	129	0
Brisbane...	159	0
Buenos Ayres. Teleg. mat.	16	0
Calcutta	616	0
Cape Town	526	0
Christiania	244	0
Colombo...	271	0
Copenhagen	367	0
Durban	644	0
East London	41	0
Gibraltar	11	0
Launceston	30	0
Lyttleton	49	0
Madeira	83	0
Melbourne	45	0
Montreal. Teleg. cable	264	0
Ostend	33	0
Port Elizabeth	164	0
St. Petersburg	850	0
Shanghai	54	0
" Teleg. mat....	367	0
" Teleph. mat....	44	0
Stockholm. Teleg. mat.	367	0
Sydney	178	0
Trinidad	366	0
Wellington	187	0
" Teleg. mat.	157	0
Total	£7,224	0

Bankruptcy Proceedings.—Under the failure of A. Gerald Duncombe, Queen Anne's Mansions, Westminster, the first meeting of creditors was held at the London Bankruptcy Court on the 7th inst. The debtor attributes his failure partly to having accepted in March last two bills of £1,000 each, the proceeds of which were to be invested in the Randall Telephone Patents Enterprise. The Randall Telephone Company, Limited, was to be formed to take over the patents and, on completion of the contract, the debtor was to receive £2,000 cash, £250 debentures, and £3,000 in fully paid shares. The company has not yet been floated. Other causes for the failure are losses on theatrical speculations, liability on accommodation bills, excessive interest charged on borrowed money, and losses by betting and gambling. The liabilities are roughly estimated at £7,000, and the assets at £100. Mr. F. S. Salaman, C.A., Bucklersbury, E.C., was appointed as trustee to wind up the estate in bankruptcy.

At a sitting of the London Bankruptcy Court, held last Tuesday, Frank W. Henton, electrical engineer, lately trading at 24, King William Street, Strand, as F. W. Henton & Co., attended for public examination upon accounts showing debts, £1,143 1s. 7d., ranking against assets, £24 8s. 10d. In the course of his evidence the bankrupt stated that he originally commenced business in October, 1891, with £100 capital, but relinquished it six months afterwards, because it proved unsuccessful. He then obtained an appointment as electrical engineer to a theatre, and in March, 1894, recommenced business at 24, King William Street, Strand. He traded there until last February, when the stock and effects were sold under an execution. His failure was caused by losses of about £400 on contracts for illuminations in connection with the Jubilee and by the action of the Alhambra Theatre authorities who disputed his claim of £442, being balance of his account for an electric light installation at that theatre. The examination was concluded.

Dissolution of Partnership.—Messrs. W. Baker, A. E. Ward, and A. Manock (Wm. Baker & Co., upholsterers, &c., and electrical engineers, 1, Broad Street, Oxford), have dissolved partnership by mutual consent. Mr. Baker will attend to debts, &c.

Books Received.—"The Theta-Phi Diagram practically applied to Steam, Gas, Oil, and Air Engines." By H. A. Golding. Technical Publishing Company, Manchester. 3s.

"Manual of Electrical Undertakings, 1898-99." Third year. By Emile Garcke. P. S. King & Son, Bridge Street, Westminster. 10s.

Catalogue.—Messrs. J. H. Tucker & Co., of Birmingham, have brought out a well illustrated and printed catalogue of electric lighting accessories. The firm's various types of switches, sockets, fuseboards, ceiling roses, cut-outs, and other fittings, are very nicely set out in this list of 38 pages.

Changes of Address.—Messrs. Moores, Farrell & Co., of 15, Hanging Ditch, Manchester, have removed to more commodious offices at Central Chambers, 26, Victoria Street, Manchester.

The British Blahnik Arc Light Company, are giving up their premises at 49 and 50, Parliament Street, S.W., and are transferring their showrooms to the factory in Iliffe Street, Newington Butts, S.E.

The offices of the London Smelting and Refining Syndicate are now removed from 39, Victoria Street to Grosvenor Mansions, Victoria Street, and all communications should be addressed accordingly.

Mr. Killingworth Hedges, C.E., has removed from 92, Victoria Street, to new offices adjoining his laboratory, at 1, Emery Hill Street, Ashley Gardens, Victoria Street, Westminster, S.W.

Chicago Slabs.—The patent Chicago slabs for application to commutators have, we understand, been permanently adopted in various departments of the Post Office, also by dynamo makers, and other electrical manufacturers in this country, and quite recently it was decided to employ them at the Royal Mint. Messrs. Raffael Bros, of Manchester, are pushing the sale over here.

Cox Thermo-Electric Company, Limited. — The creditors and shareholders of this company met last week before Mr. Wheeler, official receiver, at the Carey Street offices of the Board of Trade, in anticipation of an offer being submitted by which the creditors should receive a substantial benefit. The company was formed in February, 1896, with a capital of £100,000 in £10 shares, to acquire certain patents from Mr. Cox. The purchase price was fixed at £104,000, payable as to £4,000 in cash, and £100,000 shares, which absorbed the whole of the capital. The directors subscribed for £10,000 6 per cent. debentures which covered all the assets of the company, and with that money freehold premises were acquired at St. Albans. Unfortunately, those premises were destroyed by fire in February, 1897, and as they were only insured to the extent of £1,000 they had to be rebuilt by means of money borrowed from the bank on the security of the title deeds and the personal guarantee of the directors. A receiver for debenture holders is now in possession of the company's property. Mr. G. Paxon appeared for the petitioning creditors, and Mr. Webster for the directors. The chairman reported that accounts had been filed since the last meeting showing unsecured debts £5,235, including a sum of £2,200 odd in the name of Mr. Cox, and various amounts due to directors for moneys advanced, &c. There was further a debt of £3,000 to the London and County Bank, who held security, and the debenture holders claimed £10,000. The assets consisted of cash at bank £103; cash taken over by the receiver £7; stock in trade £3,500, but returned as unsaleable; machinery and fixtures estimated to produce £200; and the patents which were set out at £105,345, were marked as being of only nominal value. The gross receipts of the company during its business existence were returned at £4,846 and the expenses at £4,369. The deficiency of £115,000 was accounted for by depreciation in the value of the patents £105,000; buildings £1,248; stock £3,500; loss by the fire in February, 1897, £5,000; and other minor items. A letter had been received by the Official Receiver from Mr. Webster's firm to the effect that their clients were still prepared to carry out the offer made before the petition was served, and which would have been carried out long ago but for the action of a certain creditor. The terms of the offer provided for the payment of 13s. 4d. in the £ on the trade debts. He (the chairman) had to point out that no provision was made for the other unsecured debts or for the costs of the proceedings, and the condition attached to the offer was the staying of the liquidation proceedings. The proposal would clearly have to be remodelled, and under the circumstances, perhaps, the better way would be for the meeting to appoint a liquidator and committee of inspection, with power to deal with the matter. Mr. Webster said the only debts outside the trade were the claim of £2,000 by Mr. Cox, and other amounts owing to various directors and his own firm. The claim of Mr. Cox had never been regarded seriously by the directors. At the time of the fire that gentleman had a considerable number of instruments at the works of which he was naturally very proud, and upon which he set a high value. Unfortunately they were destroyed and were uninsured. He (Mr. Cox) told the directors that they ought to make the loss good, and although they declined to accept any responsibility, they promised to do something for him in the matter if the company proved a success. The other claims would, of course, be withdrawn, because the directors would simply have to pass the money from one pocket to the other. Then with regard to the costs, he could not hold out any hope that the directors would pay them, and, in fact, they would have to come out of the 13s. 4d., but that would not appreciably reduce the amount of the composition. After some further discussion, the meeting passed a resolution for the Official Receiver to act as liquidator, assisted by the following committee of inspection, viz.:—Mr. Chas. Spencer Madden and Mr. E. C. Carter (Mesken & Co.), and Mr. Robert Stanton (Stanton Bros.). A meeting of the committee will be called at an early date to deal with the offer of the directors.

Electricity for Pumping Purposes.—At the annual meeting of the South Staffordshire Mines Drainage Commissioners on Wednesday last week, further particulars were given of the proposed scheme of electric pumping (a summary of which appeared in the Electrical Review of last week) in a special report prepared by the engineers to the Commissioners, Messrs. G. Howl and G. B. Marten. They state that a new and minute survey has recently been made of all the undrained areas below Crook level, with a result that upwards of 50 sites have been located where automatic electric centrifugal pumps could be placed so as to drain 2,250 acres, which it is practicable to extend to 3,000 acres, from which 3,000 acres it is estimated that two-thirds of the rainfall, equalling on an average 3,000,000 gallons of water per day, are passing into the mines, the pumps to commence working immediately the storms fill the catch

reservoirs, and to continue to work until the lowering of the water shuts off connection with the motors. Fifty electrical pumps, raising 500,000 gallons per day (1½ H.P. each) would equal 25 million gallons per day. This apparently excessive power is proposed to be installed to meet heavy storms, and more particularly rapid thaws during the time the earth is covered with a thick layer of snow. If the pumps dealt with 3 million gallons per day on the average of the year, which it is estimated might be caught by the additional surface drainage, it would mean that they would only have to work one-eighth part of their time, or less than one day per week. The cost of the electric energy to be supplied by the Midland Electric Corporation for Power Distribution for doing this work, calculated at 1½d. per Board of Trade unit, would be £670 per annum, after allowing 50 per cent. for loss in the current and slip in the pump, which is only £100 more than is at present expended on surface pumping. To this cost would have to be added wear and tear, stores, and the attention of, say, two men.

Important Company Prosecution.—On Friday last the Hampstead Electric Supply Company, Limited, of 64, Victoria Street, S.W., were summoned at Westminster by Walter Cope, on behalf of the Companies' Guardian Society, Limited, 9, St. Mildred's Court, Poultry, E.C., for having, on various specified dates, refused inspection of their register of shareholders during business hours, the legal charge for such inspection being tendered. Mr. T. D. Dutton, who appeared for the complainant company, stated that their object was to supply information to subscribers, and protect the public against fraudulent companies. That was their main object. With a desire to obtain information as to the Hampstead Electric Supply Company, which was registered in July, and for which a public subscription was taken at the end of that month, an agent of the complainant company called at the registered office of the defendants on various dates in August and demanded an inspection of the register, tendering 1s. on each occasion. Every time application was made excuses were advanced, and the register could never be seen, although since the summons had been issued and served notification had been received inviting inspection of a register. This was found to be incomplete in important particulars. Evidence was given by Walter Cope on behalf of the complainant company, who bore out what Mr. Dutton had said as to the failure of witness to obtain an inspection of the register. On one or two occasions he saw the secretary, Mr. Goffin, who informed him that the register was not made up, the allotments not being completed. Mr. Goffin added that as soon as the allotment was completed intimation of the fact would be given. Mr. Edmunds, for the defence, contended, on the authority of a case, that the refusal to allow inspection must be distinct and definite. Mr. Shiel said their was plenty of evidence of refusal, and if excuses of that sort were allowed the register might never be completed. Mr. Edmunds then submitted that the case was one in which there were extenuating circumstances, as the secretary had sustained a severe domestic bereavement. Mr. Sheil said the company was registered in July, and certainly the register ought to have been completed within a month. He should take no excuse for the neglect that had been shown, for the protection of the public demanded that the provisions of the Companies Act should be most rigidly adhered to. He imposed a fine of £10, and, as it was a very proper prosecution, should allow £5 5s. costs.

The Late Dr. Hopkinson.—Mr. Charles Hopkinson, of 26, Victoria Street, S.W., announces that he has decided to continue both in London and Manchester the practice in which he was associated with the late Dr. John Hopkinson. He has accordingly arranged to take into partnership the late Dr. Hopkinson's eldest son, Mr. Bertram Hopkinson, B.Sc., who has had considerable experience of expert work in connection with patents. His University training and his close association with his father during the last few years equip him well for the electrical work which forms so important a part of modern engineering. Mr. Ernest Talbot, who has been in Dr. Hopkinson's personal employment for 25 years, and to whom he had of late years entrusted much of his detailed work of design and supervision, will also become a partner.

Lists.—The United Asbestos Company, Limited, have issued a revised price list showing reductions which have been effected in the prices of "Salamander" decorations, on account of improved manufacturing facilities and increased demand.

The Crypto Works Company, Limited, of Clerkenwell Road, E.C., have issued a new price list, in which they describe, illustrate, and price various types of small-sized dynamos and motors and other electrical apparatus made by them.

The General Electric Company have got up an abridged list of their telephones, for the purposes of the trade. The list contains, in eight pages, numerous illustrations of telephone systems for a variety of uses. Wall and table pattern office apparatus, the "General" intercommunication system, magneto-call and other telephones are described and prices given. It is the company's intention to present each £10 trade customer with 1,000 of these lists with his own name and address printed thereon, this being considered an inducement to small tradesmen to push the telephone business.

The Universal Electric Supply Company, of Moss Side, Manchester, have issued the fifth edition of their price list, containing particulars of a variety of small electrical apparatus and accessories, including bell, telephone, and lighting and sundry fittings.

The Edison & Swan United Company have issued a special leaflet (No. 115) of glass shades. The various shapes of shades are printed in several colours, for the purpose of letting buyers see at once from the list what they are purchasing. There are some very neat designs shown.

A New American Rubber Wire Factory.—An American exchange says that the John A. Roebling's Sons Company is now manufacturing rubber insulated wires at its new factory recently completed in Trenton, N.J. The very best and latest machinery has been installed for preparing the rubber for insulating all sizes and kinds of electrical conductors from wires for houses and cars, &c., up to the heavy lead encased cables for power and light plants, working under high tension currents. While hitherto supplying rubber insulated wires in large quantities to the trade, there has been some disadvantage in not actually turning out the product entirely from the raw material at the company's own works. With every appliance in the way of rolling mills, wire mills and other machinery, it became imperative for the company to supply its own "Roebling" rubber wire to its customers, taking advantage of the reputation of the products of its mills. The new factory is located conveniently near the other parts of the electrical wire department, and has ample shipping facilities both by rail and water. The heavy machinery is installed on the ground floor of a large three-storey brick building about 60 feet by 160 feet. The other floors are utilised for lighter machinery, drying rooms, &c.

Partnership Notice.—Dr. O. J. Steinhart, F.C.S., and Mr. J. L. F. Vogel, A.I.E.E., have entered into partnership, and have fitted up the Blackfriars Testing Works, 91, Blackfriars Road, S.E., with the object of carrying out investigations, testing, and experimenting in all kinds of electro-chemical and electro-metallurgical work. The object of the installation is to try such processes on a scale of sufficient magnitude to enable the commercial value to be ascertained, and they have installed at present a 12-H.P. motor and a continuous current dynamo giving 700 amperes at voltages varying from 1 to 10·5, together with all the necessary instruments, &c., for carrying out such work. They have also complete laboratories for work in its more initial stages. They consider that, although electro-chemical work is progressing with rapid strides on the Continent and in America, it is more backward in this country, and many processes which have stood the test of laboratory work satisfactorily, have never reached a commercial trial owing to the enormous expense of erecting special plant, &c., in each separate instance for the intermediate trials between the laboratory and the factory, which are so essential to every new technical process.

South African Electrical News.—The October issue of *The British and South African Export Gazette* contains the following items of electrical interest:—Tenders for the supply of electrical plant comprising engines, boilers, dynamos, condensing engines, &c., have been called for by the Johannesburg Town Council. Tenders are to be forwarded to the secretary, Mr. M. Adolfs, on or before the 28th inst. The long-considered scheme for the installation of the electric light at Bloemfontein has at last approached a definite stage of realisation by the acceptance by the Town Council of the tender of Messrs. Reunert & Lenz, of Johannesburg. The installation is to be carried out for a sum of £16,500, out of which £1,000 is allocated for the provision of an engine room. The same firm have also in hand the electric lighting and tramway installations for East London and the electric lighting of the Grahamstown Exhibition, besides the installation of an electric equipment of a large building in Johannesburg, and the electric plant for the Bank of Africa's branch at Lourenço Marques. An order for the electric lighting installation for the Pretoria Theatre has been placed with an American firm. The Johannesburg Town Council having been empowered to raise by a debenture issue the sum of £150,000 for electric lighting purposes, two thirds of which sum will be devoted to the purchase of new machinery, street extensions, and other works. Opportunity for the securing of some valuable orders should be afforded. Orders have been placed for a complete electric lighting and power installation for the new premises of Messrs. J. D. Cartwright & Co., glass, china, and earthenware importers, Cape Town. A company, with a capital of £5,000, has been formed at Ladysmith, Natal, for the purpose of promoting the electric lighting of the town. The scheme comprises, for a beginning, a boiler, steam dynamo, pump, switchboard, four storage tanks of 2,000 gallons each, 860 lamps of 16-C.P., &c., of an estimated cost, with the building, of £3,500. The contract for the electric lighting of Port Louis, Mauritius, has been placed with the Birmingham Installation Company, the estimated cost being £75,000.

Theft.—For stealing six pieces of electric cable, value 15s., the property of the Bristol Corporation, Charles Watts, a workman in the employ of a contractor who was carrying out some constructional work at the electric light station, Temple Back, has been sentenced at the Bristol Police Court to one month's hard labour.

W. T. Glover & Co., Limited.—From our small advertisements this week, it will be seen that 2,000 £1 ordinary fully-paid shares in the above company are to be offered for sale by public auction at Manchester on October 20th, by Messrs. C. W. Provis and Son.

ELECTRIC LIGHTING NOTES.

Accrington.—Mr. W. J. Newton, the borough engineer, has recently submitted his report on electric lighting and dust destructors to the Electric Light and Health Committee. He submitted plans, &c., to Messrs. Beaman & Deas, Limited, the Horsfall Furnace Syndicate, and to Messrs. Manlove, Alliott & Co., and tenders, &c., had been received. The Accrington Council has 12,000 to 14,000 tons of refuse disposable per annum. Mr. Newton says that a combined scheme will result in a great saving in the cost of fuel. The Committee will look into the matter and make recommendations.

Airdrie.—At the Town Council meeting last week, Councillor Ewart stated that the Lighting Committee had met Mr. Lawson, the electrical engineer of the House-to-House Electricity Company, and he had arranged to fit up a new lamp at their works in Coatbridge to give them an idea of what it was like. The Coatbridge street lamps at present were 2,000 candle-power, but this one was not so strong. Councillor Harvie said they thought that if they had a greater number with the lesser light it would serve their purpose better. Opinions were expressed that the Council should keep its provisional order. It was also thought that they should get the report of an expert to see what it would cost to make it a Corporation scheme.

St. Albans.—The Corporation, who hold a provisional order from the Board of Trade for electric lighting, have, we understand, been approached by two or three syndicates for the purpose of utilising the order, but the terms offered have not been tempting enough to the Town Council.

Alloa.—The Burgh Commissioners having already resolved to apply for a provisional order, passed a resolution on Monday instructing their Parliamentary agents to take the necessary steps to that end.

Amblecote.—The Lighting Committee recently met the Consulting Committee of the Stourbridge Council on the question of the electric light; but as the Consulting Committee of that Council had not proposals to place before the committee, there was no business done. Subsequently the committee met the consulting engineer to the Midland Electric Corporation, Limited, and the district superintendent of the British Electric Traction Company, Limited, but as no definite information could be gleaned from either source as to the comparison and price of electric lighting, both public and private, the committee recommended that no further steps be taken in the matter of electric lighting at present.

Aylesbury.—Edmundson's Electricity Corporation have signified their intention of applying to the Board of Trade for a provisional order for electric lighting in Aylesbury.

Ayr.—Part of the extension machinery was recently started, and a scheme for extending the arc lighting is in hand. It is proposed to light the Esplanade—about a mile long—with 18 arcs.

Bacup.—The Town Council last week resolved, on the recommendation of the General Works Committee, that the electric lighting order of the Corporation should be transferred to a company to carry into operation on terms to be arranged.

Bangor.—Mr. Meade King, on behalf of the Local Government Board, on Wednesday held an inquiry touching an application by the Town Council for power to borrow £13,000 for electric lighting. Mr. Medhurst gave evidence. The scheme was opposed by the Ratepayers' Association. Mr. Medhurst said that the scheme was a three-wire low tension system with 400 volts between the outer mains. The plant of the generating station would comprise two water-tube boilers, and steam dynamos of 60 kilowatts, giving a capacity equivalent to 4,000 8-candle-power lamps. The network of mains would be laid in the compulsory area with feeder mains from the station to various points. They would be laid direct in the ground, would be paper insulated, lead covered, and armoured with steel tape. Tenders had been advertised for, and had been received, for everything excepting the building, so that the figures he would give were those of the actual tenders, which, as a matter of fact, he had recommended for adoption. The total outlay would be £12,851, allowing an estimate of £3,000 for buildings. The Council had actually a guarantee for 4,000 lights of 8 C.P.

Last week Dr. Grey Edwards submitted to the Council the report of the Special Lighting Committee, which had considered tenders for electric light plant. There were 66 tenders received, and these have been sent to the electrical engineer to make recommendations for the guidance of the Committee.

Barrow.—The Highways and Lighting Committee has accepted the offer of the Electric Lighting Committee to place 21 electric arc lamps in Abbey Road, Duke Street, and Dalton Road up to the end of the present financial year at £15 per 1,000 C.P. per annum. The proposal has been approved by the Council, also the plans of the Electric Lighting Committee for laying mains in certain roads.

Bath.—The Electric Lighting Committee has had a discussion *re* the charges for current. It was decided not to make a reduction until the financial statement for the year had been presented.

Bedford.—The Town Council last week resolved to lay mains in a few additional roads for public and private lighting.

Belfast.—The Electric Committee are still of opinion that the Corporation should proceed with a Bill to give them power to use electricity for the propulsion of tramcars, particularly on new routes and their connecting links. The opening of the new lighting station takes place next Tuesday.

Birkenhead.—The Town Council has resolved to apply to the Board of Trade for a license authorising the Corporation to supply electricity for public and private purposes in the districts of Bidston and Noctorum.

Buckley.—The Urban District Council has decided that a special meeting of the Council shall be held on November 9th for the purpose of instructi the clerk to apply for a provisional order for electric lighting. Thirty-four applications were received for the post of electrical engineer, and eventually the appointment was given to Mr. Peers, Deansgate, Manchester.

Cambridge.—We understand that an appeal made by the Cambridge Electric Supply Company, Limited, against the rating of their concern will be heard at the Quarter Sessions to be held at the Guildhall, Cambridge, on Tuesday next, the 18th inst. Mr. Castle, of 40, Chancery Lane, and Mr. R. E. B. Crompton will give evidence on behalf of the company.

Canterbury.—A private party of Town Councillors and one or two others went over to Boulogne on September 28th for the purpose of seeing the electric lighting and electric tram system there. The Mayor of Boulogne rendered the party every assistance.

Castleford.—The Triticine Company wanted to enter into an agreement with the Urban Council for the supply of electricity for the district, but the Council will not entertain the proposal. Mr. Hammond has therefore been asked to complete his report on a scheme, and application is being made for a provisional order.

Castletown.—The clerk to the Sunderland Rural Council is asking the Monkwearmouth Colliery Company whether it intends lighting Castletown by electricity.

Cheltenham.—At last week's Council meeting the Lighting Committee reported that the electrical engineer's report showed that the number of customers connected was 269, equivalent to about 16,140 8 C.P. lamps, and that the number of arcs in use was 121. His estimate of the cost of lighting by arcs the following roads was—(*a*) College Road from High Street to Sandford Road, from College Road to Bath Road, Bath Parade (one arc) and St. Luke's Road (two arcs), £1,300 for 15 arc lamps, those in College Road to be suspended over the road; (*b*) Suffolk Square (north side), Suffolk Parade, and Great Norwood Street from Montpellier Terrace to the Railway Inn, £860 for 13 arc lamps; (*c*) Priory Lawn Road, arc lamp, £55. These, and some small extensions of cables, were approved by the Town Council, and sanction to a loan for £2,500 for the purposes will be applied for. The deputy-mayor, in drawing the Council's attention to the matter, remarked that the cables for street lighting were now laid along between four and five miles of streets, and that the number of private customers for the current was 269, as compared with 24 when operations were commenced. The electrical engineer is experimenting with enclosed arc lamps.

Christchurch.—At last week's Town Council meeting, the Mayor (Councillor G. Marshall) reported that he had had an interview with a representative of the Bournemouth and District Electric Lighting Company, whose draft order was in the hands of the town clerk for consideration by the Municipal Committee. The company were already established in Bournemouth, with the difference that the interest of the old Bournemouth Company was being transferred to the new company, who were anxious to obtain the consent of the Christchurch authorities to establish works in Christchurch. The position, he said, was, that if the Town Council refused consent the company could not possibly proceed. It was resolved that the representative be invited to attend the next meeting of the Municipal Committee.

Church Lighting.—The new Roman Catholic Church at Shielmuir, Wishaw, which was recently completed, is fitted throughout for the electric light, both inside and at the entrance door. The Roman Catholic manse and school is also similarly lighted.

Devonport.—At the last Council meeting the report of the Electric Lighting Committee was presented by Mr. Canniford, who said they were using every means in their power to expedite the business. Several sites which were considered suitable were submitted to Lord St. Levan, and he hoped at the next Council meeting to be in a position to recommend the purchase of one.

Dublin.—At last week's meeting of the Corporation a letter was read from the town clerk with reference to Messrs. Callender Cable and Construction Company's contract. In his letter the town clerk pointed out that the specifications entered into between the Electric Lighting Committee and the Callender Company provided for steel tape armour for the cables, and what the company were now laying down was not steel tape armoured, but bitumen was used instead. A question was also raised as to the thickness of the troughing. Prof. Kennedy's representative's attention having been called to the divergency, he reported that Mr. Callender had made a clerical error in inserting the word in the specification. Prof. Kennedy, in a letter, also said that the bitumenous system was very much more extensively used, and that it would not be to the interests of Dublin to use steel-covered cables. Alderman Meade said they must not delay in this matter. The Committee were overwhelmed with applications from other parts of the city for electric lighting, and the Committee were unable to give it. He thought that if the steel tape system was more expensive the Corporation should get a rebate from the company for the difference. He would now move that the matter be referred to the Committee, with power to act in the matter according to what was best in the interest of the Corporation. The resolution was adopted.

Dundalk.—A conference took place on 3rd inst. in Dundalk between the Town Commissioners and the representatives of the syndicate who have in contemplation a tram and electric lighting scheme for Dundalk. The conference was brought about

with a view of arriving, if possible, at some means of settling points of difference in reference to the lighting agreement. The Commissioners have a provisional order for electric lighting which they propose to hand over to the tramway company, and in return for this and for the free grant of wayleave through the streets for the tramways, they expected the company to light the town, and also the Town Hall, with electricity at a low figure. The chief points at issue have been as to the number of lights, the price, &c. The Commissioners at present pay £525 for gas lamps. The syndicate offered to provide 22 arc and 50 incandescent lamps for £600 a year. The Commissioners thought the number insufficient, and required the insertion of a clause binding the syndicate to provide extra lamps without cost if the light afforded by the number stated should prove to be inferior for the purpose of lighting all the streets of the town to that of the present 211 gas lamps. The syndicate declined to insert this clause, but offered to add 10 incandescent lamps, to light the Town Hall passages and municipal offices practically free of cost, and made certain other less important concessions. The Commissioners will hold a special meeting to consider the matter as it now stands. It is possible that even should the lighting scheme fall through, the portion relating to the electric tramways between Blackrock and Dundalk may be proceeded with.

Dundee.—The Gas Committee has decided to recommend a reduction of the rate to all consumers above 10,000 units from 4d. to 3d. per unit.

East Grinstead.—The District Council has received a letter from the Urban District Council's Association advising them generally as to the means to be adopted in obtaining a provisional electric light order. The matter was referred to the General Purposes Committee.

Edinburgh.—At a meeting of the Electric Lighting Committee on 4th inst. it was reported that during the previous fortnight the number of applications received equalled 3,196 8-C.P. lamps. Since May 15th applications have been steadily coming in at the rate of 1,500 per week.

Elland.—At last week's District Council meeting Councillor Thornton moved that steps be taken to obtain a provisional order for electric lighting. Some members opposed the motion, and ultimately it was defeated by 8 votes to 3.

Failsworth.—The District Council have held one or two special meetings lately for the consideration of the electric lighting question, and the solicitor to the Council has been instructed to take the necessary steps to procure powers.

Fareham.—At the last meeting of the District Council, the Electric Lighting Committee reported that they had considered a question raised by a member with regard to the item in last year's accounts of the electricity works:—"Electric current unaccounted for, 10,498 units," as against 3,770 units the previous year. The electrical engineer had pointed out that there was an increase in the number of hours the machinery was running of from 2,860 hours to 4,166 hours; and, further, that last year's loss was calculated in a different but more accurate manner from the ammeter sheets. The loss arose chiefly in the transformers. At the request of the Committee, the engineer had obtained comparative figures of units generated and lost in electricity works of other towns, and a perusal of a table which had been prepared showed that the Fareham works compared most favourably with them. In connection with this subject, there arose the question of all-night running, where the greatest proportion of waste or loss occurred, but the Committee proposed to defer any report upon this point until the spring. An opinion was expressed that £60 per annum was lost by the engines being kept running all night for the convenience of private lighting.

Fulham.—The Fulham Vestry is proceeding slowly with its electric lighting scheme. The consulting engineer, Mr. Medhurst, has, according to *London*, sent identical specifications for the construction of a combined dust destructor and steam-raising plant to Messrs. Manlove, Alliott & Co., Messrs. Beaman & Deas, Limited, and the Horsfall Furnace Syndicate, Limited. All three firms, it is curious to note, have objected to the somewhat stringent financial conditions and guarantees embodied in the specification, and one—Messrs. Manlove, Alliott & Co.—has declined to send in a tender at all. Messrs. Beaman & Deas's tender amounts to £16,520, and that of the Horsfall company to £16,760. The former, however, includes four of the firm's patent double-cell destructor furnaces (equivalent to eight cells), whilst the Horsfall company's tender includes 12 cells. The consulting engineer recommends the Vestry to accept the latter. It is proposed to sink a well on the Town Mead site in order to obtain a supply of water for the new works.

Gateshead.—The Parliamentary Committee has received a proposal for the electric lighting of the borough from the Electrical Power Distribution Company, Limited. The Committee will interview the company before making any recommendation.

Glasgow.—The Corporation is advising all customers who applied for supply after July 1st that they will be supplied with current at 250 volts pressure.

Greenock.—The Law and Finance Committee has recommended that Mr. S. E. Fedden, of Edinburgh, be appointed electrical engineer for the town.

Halesowen.—The General Purposes Committee recently read a communication from the Midland Electric Corporation, stating that they desired to enter into an arrangement with the Council for the supply of electrical energy in the district. The representatives of the Corporation attended before the Council, and after hearing their opinion, the Council decided to make an application for a provisional order.

Hampstead.—The Vestry has resolved that the line of thoroughfare extending along Quex Road, West End Lane, and Fortune Green Road, from High Road, Kilburn, to Fortune Green, also along Mill Lane, from West End Green to Ravenshaw Street, be lighted by means of arc lamps, at an estimated cost of £2,272. The Electric Lighting Committee has been empowered to take the necessary steps for obtaining tenders for supplying the requisite plant for the completion of the scheme.

The Vestry clerk has been instructed to take no further action toward joining other corporations in defending the action brought by Mr. Rucker in respect of the Zipernowski patents.

The Board of Guardians have decided to take current for lighting their house from the Vestry, and not to instal separate plant.

Hartlepool.—On 5th inst. the Town Council passed a resolution directing the town clerk to take steps to procure a provisional electric lighting order.

St. Helens.—In consequence of the death of Dr. Hopkinson, the Electric Lighting and Traction Committee recommended, at the last Council meeting, that Mr. J. S. Highfield, at present resident electrical engineer to the Corporation, should be appointed electrical engineer, his duties and salary to be fixed at a subsequent date. The proposal was agreed to.

Hereford.—The Electric Lighting Committee has signed a contract for the purchase of a site for electricity works for £1,650. A special Council meeting will be held this month to deal with a report of the Committee in regard to carrying out the scheme.

Ilkeston.—The Council last week amended the minutes of the Tramways and Electric Lighting Committee by reducing the streets in which an electric lighting supply should be laid for private consumers to Bath Street, Market Place, and Market Street.

Lewisham.—The Blackheath and Greenwich District Electric Lighting Company's notice of intention to lay mains in various roads in the parish have been approved by the Lewisham District Board, subject to the consent of the London County Council. The company asked how many public lamps the board required lighted, but the board has replied that, at present, it does not wish to go in for public electric lighting. The company has purchased a site for works, and placed contracts for the erection of buildings and laying of mains.

Leyton.—The Local Government Board has sanctioned a further loan of £5,000 for 25 years in respect of extensions. The Electric Lighting Committee secured tenders for the additional plant, and recommend the acceptance of the following:—(1) Gas plant—The Dowson Economic Gas and Power Company for the sum of £837 15s. (2) Dynamos—The Fuller-Wenstrom Electric Company for the sum of £484 14s., subject to the working of the dynamos recently supplied by them proving satisfactory. (3) Gas engines and piping, &c.—Messrs. Wells Bros. & Co., at schedule rates amounting approximately to £1,000. (4) Switchboards—Messrs. Laurence Scott & Co. for the sum of £50, subject to deductions and additions as per schedule rates. The Committee, pursuant to the authority given to them by the Council, have accepted the tender of the Fuller-Wenstrom Company for the supply of motor pump at the price of £65. The Finance Committee have been requested to provide the sum of £1,115 for the purposes of the Committee in their next estimate, being the amount required to meet the repayments of principal and interest on loans falling due during the ensuing half-year. In the opinion of the Committee it is not necessary to make further provision out of the rates during the ensuing half-year for the working or other expenses of the electrical department.

London, E.C.—At the Court of Common Council held last week, Mr. Brooke-Hitching asked Mr. Turner if he could inform the Court whether any steps had been taken by the Streets Committee with regard to the lighting of the side streets of the City by electricity, or the purchase of the City of London Electric Lighting Company's undertaking. Mr. Turner reminded the Court that the question was a very difficult one to answer. He did not think it would be possible for him to bring up a report on the whole question during his occupancy of the chair, but before he left the chair he would endeavour to complete a report on the subject of the lighting of the side streets. Mr. Brooke-Hitching asked whether, seeing the serious nature of the question, the Committee would appoint a sub-committee to consider the proposed purchase of the electric lighting company. Mr. Turner remarked that a sub-committee was already in existence.

Loughborough.—The Corporation is taking steps with a view to purchasing the gas undertaking. A committee is of opinion that some of the public buildings and business premises might advantageously be lighted by electricity, and the Corporation will therefore apply for a provisional order for electric lighting.

Ludlow.—The Public Lighting Committee has considered the steps to be taken in the matter of applying to the Board of Trade for a provisional order, and found that certain data should be gone into before the various papers were drawn up and submitted to the Council. The capital proposed to be expended in connection with the undertaking was £6,500.

Marylebone.—Copies of the minutes of the proceedings of the House of Commons relating to the Vestry's application for a provisional order are to be circulated among the members. It seems that the Vestry has by no means dropped the matter.

Middlesbrough.—At a special meeting of the Electric Lighting Committee on 5th inst., plans and specifications drawn up by Mr. Hammond for the proposed scheme for the electric lighting of the borough were considered. It was originally intended to lay down plant estimated to cost £25,000, but a larger scheme was suggested, and it was unanimously thought that this would prove more advantageous to the town. This scheme was adopted, and it was decided to apply to the Local Government Board for sanction to borrow £36,000, to be repaid in 30 years.

Monmouth.—The Drainage and Electric Lighting Committee recommend that the Council advertise without delay for an electrical engineer to take charge of the generating station. It is expected that the installation will be running by Christmas.

Nelson.—The Gas Committee has decided to make application to the Local Government Board for further borrowing powers, amounting to £11,000, for increasing the supply of electric light within the borough. It is stated that the present plant is totally inadequate.

Newcastle.—On 7th inst. explosions occurred in three of the electric lighting street boxes in Osborne Road. The covers were blown off, but no one was hurt.

North Berwick.—At a meeting of the North Berwick Gas Commissioners last week, it was stated that, in response to the circulars sent out to the principal householders, it was ascertained that the probable number of lights to be used at the outset, in the event of the introduction of the electric light into the burgh, would be only 794. This being considerably short of the number requisite to make the scheme a feasible one, it was agreed to abandon the matter for the time being.

Northwich.—The Urban Council have instructed the Electric Supply Company to fix arc and incandescent lights as an experiment to test the efficiency of electricity compared with gas for street lighting.

Norwich.—On Friday evening last there was a failure in the private electric supply. At the Norwich Post Office considerable inconvenience was occasioned. A local paper says that the cause of the failure was a subsidence in the soil which disarranged a culvert.

St. Pancras.—At the last meeting of the Vestry the Dusting and Refuse Destructor Committee reported having considered the question of fixing in the destructor yard the three boilers removed from the Regent's Park central station, and had conferred with Mr. Baynes, the chief electrical engineer, thereon. The engineer explained that it would be necessary to place the boilers over the cells, and expressed the opinion that it would require at least three cells to heat each boiler. He proposed that two of the boilers should be fixed above the six south cells, and be provided with a by-pass for the escape of the heat when the boilers were not in use. He also informed the Committee that it would be advisable for an arrangement to be made whereby the furnaces might be stoked with fuel, if found necessary, during the hours of full load. On the recommendation of the Committee, the Vestry authorised the carrying out of the suggested arrangement.

Plymouth.—At Monday's Council meeting, Mr. Dutton asked the borough surveyor, in reference to the stack being built just behind the electrical buildings, was it a fact that salt water had already percolated into the foundation there; was it not generally supposed that the foundations were too deep, and was it not likely they would have a considerable amount of trouble in the future from dampness, whether the flues were cemented or otherwise. The borough surveyor said salt water had made its appearance. The level of the foundation was not too deep, and he had no fear with regard to the flues when constructed.

Romford.—Last week the Council discussed whether to take steps to obtain powers to supply electric light and power in the district. The matter was referred to the Lighting Committee, with power to act.

Rothesay.—The engineer for the scheme for lighting the front (Mr. T. C. Fulton) has been instructed by the Electric Light Committee to obtain estimates of the cost of an installation.

Sale.—The District Council Electric Lighting Committee will hold a special meeting to go further into the question of electricity supply, whether to take it from Manchester or Stretford, or what else to do.

Shipley.—The Urban District Council last week resolved to apply to the Board of Trade for a provisional order for electric lighting. Mr. James Roberts quoted figures to show that ample power would be generated by the burning of refuse, not only for the pumping of sewage at the sewage works, but also to provide electric light.

Shoreditch.—The London County Council, in view of the accounts issued concerning the working of the Shoreditch electric light and refuse destructor works during the first nine months, have objected against the rating of £600 gross, £500 rateable value, which was fixed by the Vestry on the basis of structural value. The Lighting Committee now state that, on their behalf, it has been agreed that the fairest basis of assessment was that adopted in the case of railways, tramways, and gas and water companies, viz.:—on the actual annual profit arising therefrom, which is what a tenant from year to year would give for the undertaking. For this purpose it was in the Vestry's interest that the dust destructor and electric lighting undertakings should be treated as one undertaking, and that the net result of their joint working should be arrived at. This has been very carefully done by the Council's valuer, who has taken the figures of the Vestry's accounts published to March 25th, 1898, and treating the undertaking on the ordinary commercial basis as if managed by a private company, and charging £500 per annum for establishment charges against the revenue, and £800 per annum for depreciation (on the basis of the plant, &c., wearing out in the respective periods for which the loans in respect of them were granted by the London County Council), the gross value of £1,800 is arrived at with a net rateable value of £834, whilst the estimate for the year's working from 1898-9 is £3,834 gross, and £2,950 rateable. It was thought best to fix each year's rating upon the actual profits earned, instead of taking a mean for two years, so that the present assessment has been agreed at £1,800 gross, £834 rateable, which is considered reasonable upon the figures of the accounts, especially as any saving of the Vestry by destroying dust over the old system of disposal by canal is not taken into account. As these figures are ascertained by a high independent authority as the actual commercial result, on the basis of the rate of profit earned in the first nine months, the Lighting Committee state that they are of value from other points of view than that of rating. On the recommendation of the committee the Vestry has approved this method of assessment.

Slough.—The Urban District Council has instructed a Committee to draw up an electric lighting scheme for the place. There is a suggestion that superfluous steam-power at the sewage pumping station could be made use of.

Southsea.—The War Department have commenced building operations on Southsea Common, and foundations have been laid for an engine house, for the generation of electricity for the search lights at the entrance to the harbour and along Southsea Beach. The foundations are being put in for two sets of engines and dynamos, and either gas or oil engines are to be employed.

Stanford-le-Hope.—The Parish Council have accepted the tender of Mr. Simpson for lighting the parish with electricity for the sum of £135 from October 1st, 1898, to March 25th, 1899. Under his agreement with the District Council Mr. Simpson will supply 50 16-C.P. incandescent lamps for the street lighting, and will also be permitted to supply current for private consumers. The capacity of the plant which he is putting down is equal to 500 lights. The plant to be first installed will comprise a 22-H.P. Priestman oil engine and a 240-volt 30-ampere Ediswan dynamo, an Ediswan switchboard, and a battery of accumulators. The cables are being made by the Telegraph Manufacturing Company.

The Council has decided not to approve of the proposal of the gas company to apply for a provisional order for electric lighting.

Stretford.—At last week's monthly meeting of the District Council, Mr. T. Johnston said the sub-committee appointed to deal with the question of employing another electrician in reference to electricity had met, and they were giving the matter their most careful consideration.—Mr. W. Wardale said he would like the ratepayers to know that three members of the sub-committee had refused to serve that evening. Their reason for adopting that course was, that until the feeling of the ratepayers of the district had been ascertained, it would be premature for the Council to go to the expense of engaging an eminent engineer to give information which might not be accepted by the ratepayers. At the largely attended meeting of ratepayers of Old Trafford, the separate scheme was unanimously condemned, as it would be, he was certain, if a poll of the ratepayers were taken upon it. The General Purposes Committee's recommendations, which included the proposal that the advice of an eminent electrician be obtained, was passed by 8 votes to 7.

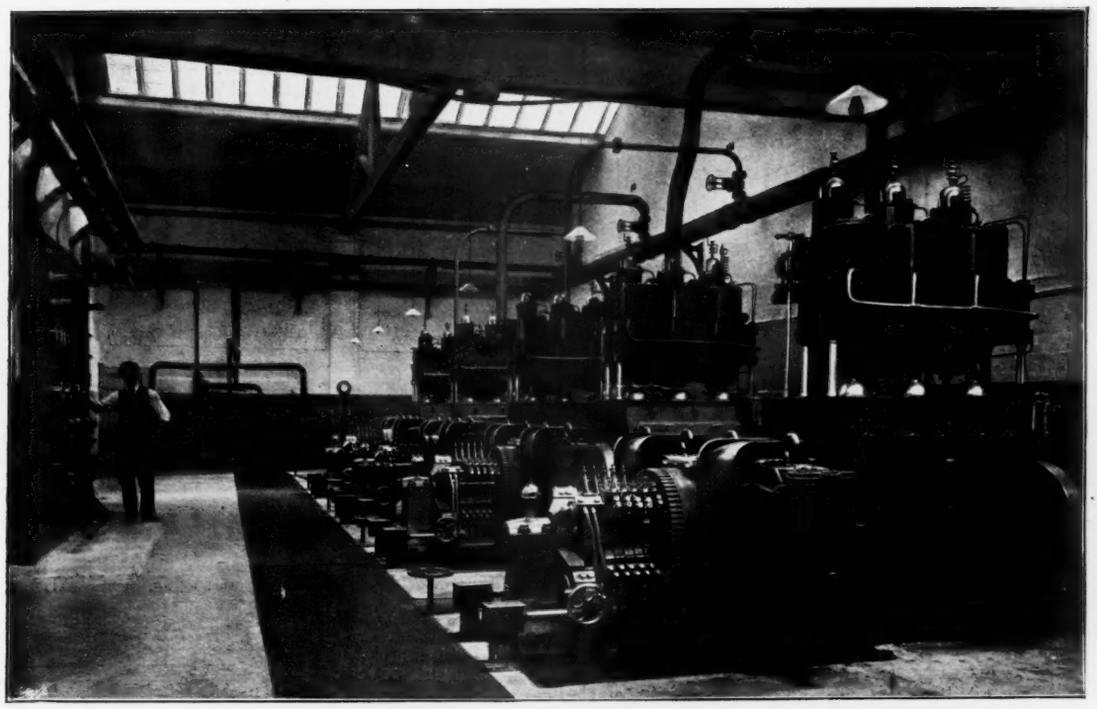
With reference to our "Electric Lighting Note" *re* Stretford a fortnight ago, a correspondent writes as follows:—"The instructions given to Mr. F. F. Bennett, consulting engineer, of Manchester, and to Prof. J. A. Dawson, by the Council, differed very materially. Mr. Bennett, in 1896, received instructions to draw up a report upon electric lighting alone, and the town's refuse was to be utilised for this purpose. Owing to the fact that the district contains two centres of population 2½ miles apart, and no possible demand existing in between, the question of cartage of refuse was a very serious factor to deal with, and would have been a very heavy item to debit the costs of working one station. He therefore recommended, as the cheaper method, two stations, one for each centre of population. Prof. J. A. Dawson, on the other hand, had instructions to draw up a scheme for lighting and electric traction, refuse destructors forming no part of his programme. The estimated revenue, costs, and profits for lighting in both engineer's reports all but coincide, notwithstanding the one recommending a three-wire low tension system, and the other a high tension alternating system. Subsequent to both reports, Mr. Bennett has furnished another report and estimates for lighting and haulage, in which the refuse destructors are left out altogether, and therefore one station suggested to deal with the whole district."

(*Continued on page 565.*)

THE DUMOULIN COPPER DEPOSITING PROCESS.

By JOHN B. C. KERSHAW, F.I.C.

On August 30th last, the writer paid a visit to the odorous town on the banks of the Mersey, which during the latter half of the present century has been the chief centre of the English alkali industry. Happily the day was fine, and the smoke and smells of Widnes were not hanging about the ground in the manner that is customary when rain has fallen, and the air is charged with moisture. The greater purity of the atmosphere as compared with that observed during earlier visits by the writer to this town in the eighties, is no doubt partly due to the greater watchfulness of the alkali inspectors, and to the greater care exercised in the control of the works; but it is also due to the diminution in the number of chemical works in operation, and the importance of Widnes as a chemical centre is distinctly on the wane.



The Generating Machinery—800 H.P.

New works are, however, springing up, and the object of the writer's visit was to inspect one of these—the recently completed works of the Electrical Copper Company, of London and Widnes, who have commenced the manufacture of copper tubes and sheets by the Dumoulin process. In the ordinary electrolytic copper works, the deposit of copper obtained at the cathode is rough and coarsely crystalline, and further operations are requisite before this copper is obtained in the form in which it is ultimately used. In the Dumoulin and Elmore processes, the copper is deposited upon a revolving mandrel, and is obtained in dense homogeneous form, only requiring passage through the annealing furnace to be ready for the market. These two processes differ merely in the method of obtaining dense smooth deposits while using currents of high density.

In the Elmore process, travelling agate burnishers, in conjunction with unpatentable (?) details of procedure, are said to be used; whereas in the Dumoulin process, strips of sheep skin, from which the fat has been extracted by chemical treatment, hang over this upper surface of the mandrel, and are said to prevent any roughness in the deposit.

The Dumoulin process was invented by a chemist working in M. Dumoulin's laboratory in Paris in the year 1895, and the process is protected by British patents No. 16,360, 1895; No. 9,289, 1896; and Nos. 2,709—2,712, 1897. The British and foreign patent rights were purchased by "The Electrical Copper Company," capital £500,000, in May, 1896, and the works at Widnes were built in that year, and put into operation in the latter part of 1897. The experimental works at Brumoy were also purchased by the company, and samples of tubes and sheets are being produced at this place.

The plant at Widnes has hitherto been used only for the manufacture of sheet copper, but vats have been erected for the production of boiler tubes, and tubes are now being made at the Widnes works. These are situated on land which affords plenty of room for growth and expansion in the Ditton Road, Widnes. Curiously the neighbouring works, also a recent addition to the number of metallurgical works in Widnes, is the electrolytic copper refinery of Messrs. McKechnie Bros.

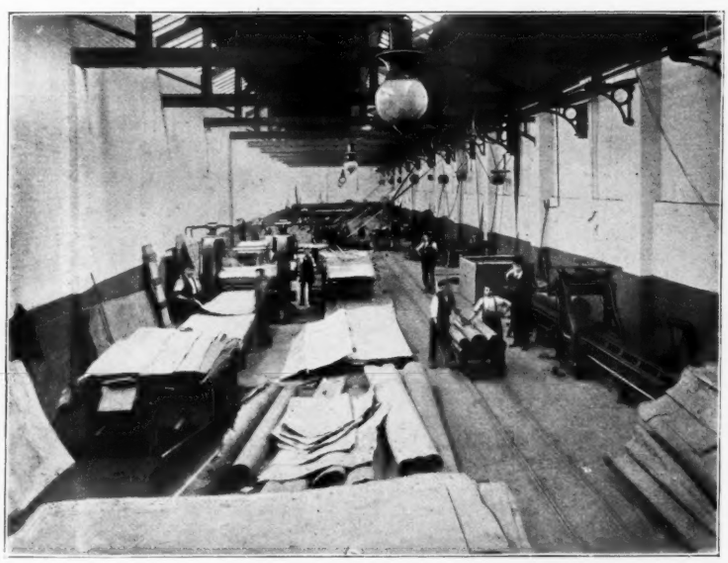
The machinery and plant of "The Electrical Copper Company" is contained in several large and well ventilated brick buildings, each operation in the conduct of the process being carried on in a separate building.

The generating machinery comprises five Peach engines direct coupled to five Crompton dynamos. The engines run at 460 revolutions under a steam pressure of 150

lbs., each engine being of 160 I.H.P. The dynamos are direct current machines, and yield 1,300 amperes at 75 volts = 97·5 kw. The engine house also contains one 40-H.P. horizonal slow-speed engine by which the machinery of the depositing vats and engineering shop is driven.

The copper depositing vats are contained in a second large building leading out of the engine house. Each vat is a shallow wooden trough, lined with lead and provided with supply and exit pipes for circulation of the copper sulphate electrolyte. This latter contains about 7 per cent. sulphuric acid, and 40 per cent. cupric sulphate.

During the passage of the electric current it is maintained in violent agitation by the revolutions of the mandrel. The mandrels are hollow cylinders of copper 12 feet long by 16 inches in diameter, capped at the ends, and mounted in insulated bearings. They are only half immersed in the electrolyte. The strips of sheep skin which give coherence and density to the deposit are held in a wooden frame, running from one end of the vat to the other above the mandrel. By means of an eccentric driven by a belt from the main shafting, a short longitudinal movement is communicated to this wooden bar, and through it, to all the strips of prepared skin which it holds. Every inch of surface of the deposit, is thus constantly lightly rubbed by these strips of sheep skin. The anodes are thick plates of raw copper, roughly shaped to semi-circular form and provided with flanges, by which they are supported upon the vat walls. The two diagrams given below show the general arrangement of anodes and cathodes in the depositing vat.



The Machine Shop.

A large number of these bent anode plates are placed side by side in the vat, until its length is quite occupied by them. The hollow cylinder with its capped ends is then lowered into its bearings, the electrolyte is run in, electrical contact is made and the deposition commences. The surface of the mandrel requires special treatment to prevent adhesion of the deposit.

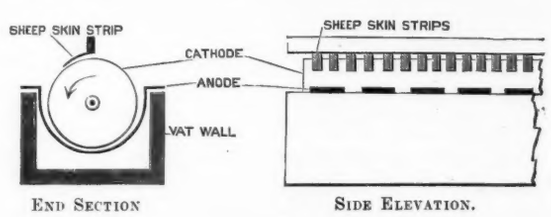
After the deposit has "struck" all over the surface of the mandrel, the bar holding the strips of sheep skin is brought into the vertical position, and the deposition of copper proceeds without further attention.

The mandrel is revolved at a high speed, and the electrolyte is kept in rapid circulation during the whole period of deposition. Under normal working conditions it requires about 10 hours to deposit 44 lbs. copper in one vat, and the tube thus obtained is about 25 gauge in thickness, and weighs about 14 ounces to the square foot. The current density used is between 35 and 40 amperes per square foot of cathode area, whereas 20 amperes is the maximum now attained in electrolytic refineries with stationary cathodes, and formerly the current density used in these rarely exceeded 4 amperes. The gain in the time required to deposit large amounts of copper at the cathode is very marked, and the output of a plant could therefore be greatly increased by use of rotating cathodes. The voltage required is about 1·6 per vat, but this rises as the anodes are eaten away. When the deposit has attained the desired thickness, the mandrel, with its casing of pure copper, is bodily removed from the vat by a travelling electric crane, and is carried to a specially designed lathe, where a longitudinal cut is made from one end of the cylinder to the other, and the resulting sheet of electrolytic copper stripped off with ease. The whole operation does not occupy more than five minutes, and after applying a special composition to the surface of the mandrel, it is again ready for immersion in the electrolyte. The sheets of copper formed in this manner weigh about 44 lbs., and have a superficial area of 48 square feet. In the case of boiler tubes, the removal of the mandrel from the interior of the deposited copper tube will be effected by means of an hydraulic press. The depositing building at Widnes contains 30 vats similar to the above, and therefore when worked to its full capacity can produce 60 of the sheets per working day. The sheets of copper are carried from the depositing house to an adjoining building where they are annealed in a muffle furnace at a dull red heat, and then pickled in dilute sulphuric acid to remove the scale of oxide formed during the annealing process. Opening out of the depositing house is a large building in which the electrolyte of copper sulphate is filtered, cooled, and pumped to the storage tanks, from which it flows by gravity through the depositing vats, back to the well in the same building. The filtration and cooling of the electrolyte after each passage through the depositing vats is found to be essential to the successful conduct of this process.

A large machine shop, a laboratory, and a store house for the finished copper complete the works.

Recent tests of the sheet copper produced by this process have shown a tensile strength of 18½—24 tons, and an elongation of 28 — 30 per cent.

The writer's thanks are due to Mr. Moir, the managing director of the Electrical Copper Company for permission to inspect this interesting process at work upon an industrial scale, and for the photographs used to illustrate this article, and also to Mr. William Langdon, the manager of the Widnes works, for the attention and courtesy shown on the occasion of his visit.



End Section Side Elevation.

220-VOLT AND ALTERNATING CURRENT SYSTEMS.

A paper upon the above subject appeared in a recent number of the *American Electrician*, the writer being Prof. Geo. D. Shepardson. He therein attempts to compare the relative advantages and disadvantages of the two systems, and also the three-wire 110-volt system (110 between outer and neutral).

Like a wise man, he studiously avoids giving his own opinions, and simply tabulates those of other people, leaving his readers to fight it out and form their own conclusions. After stating that "the main argument in favour of the use of higher voltage is the great saving in the copper required in the wires and the greater distances that may be reached," he proceeds to use the well-worn figures in support of this contention, and shows that by increasing the pressure from 100 to 124 volts, 32 per cent. of the bare copper is saved. Immediately following this observation, he says:—"If so much copper can be saved by increasing the voltage only 10 or 20 per cent., the question at once arises, why not boldly double the voltage, or even go even higher?" A rather formidable question to put to so-called low tension undertakers, who have from time to time been compelled to raise their pressure until it has gone up from 100 to nearly 500 volts, and yet will not admit that for the same reasons the high tension people are justified in using 2,000 volts or more. Curiously enough, every device for raising the pressure at the *consumers' terminals* has emanated from the supporters of "low" tension; 200-volt lamps were introduced to meet the needs of the same system, while "low tension" in the Board of Trade regulations was raised to 500 volts for the same reason.

The arguments for and against the 220-volt two-wire system are in some cases obvious and in others amusing. When comparing it with the 110-volt, for instance, the statements that "The lamps are *stronger*, being about 20-C.P. instead of 16," and that "the lamps give a more steady light," are both made in support of the 220-volt lamp. It is difficult to see what the promoter of this argument had in his mind. Why compare a 20-C.P. 220-volt lamp in "strength" with a 16-C.P. 100-volt lamp? Why not compare the "strength" of two similar lamps. It looks as though the maker intended to make a 16-C.P. lamp and evolved a 20-C.P., and then used it as an argument in favour of 220 volts!

The Dumoulin Copper Depositing Process.—The Depositing Vats.

Respecting the relative steadiness, a high tension man would smile.

Comparing 220 volts two-wire with the three-wire system, we find great stress laid upon the assumption that only one dynamo is required in the former case as against two in the latter, and that, consequently, (1) first cost is less, (2) one dynamo is more efficient than two half the size, (3) less space required, (4) one machine requires less attention and repairs than two. It does not seem to have dawned upon the people using these arguments that whatever pressure is used it is not *necessary* to use two machines on a three-wire system, and that such a method would be considered obsolete in England. Why does not America adopt the English practice of feeding the outers, and balancing with battery, motor generator, or small dynamo? Comparing 220-volt two-wire with alternating high tension, the first claim in favour of the former is startling. "All the 220-volt plants claim to be making money, while most of the alternating current plants claim to be losing continually, having *never paid expenses, &c.*" (italics are ours). We can only assume that the American practice of using small house transformers—long since obsolete in England—is responsible for this state of affairs. The statement that the "220-volt system gives better regulation, hence the light is better," &c., would again make an English high tension man smile. It would be interesting to see some pressure curves taken "unawares" on some American circuits during heavy shift. The suggestion that with alternating current arc lamps cannot be used indoors on account of the noise, is contradicted by the writer of the paper, who suggests that enclosed arc lamps make scarcely any noise. We would remark, also, that as a rule, we would rather not use arc lamps indoors. On the question of shock and lightning risks, the 220-volt people score in America, on account of the overhead wires; but when they say "there is no induction to disturb telephone circuits," and "the 220-volt dynamo may be coupled directly to the engine, thus avoiding the loss of from 2 to 5 per cent. in the belting," &c., we can only remark that the credit is not due to the 220-volt system in either case, nor is the fault due to the alternating system, but to those American engineers who misuse it.

On the other hand, some of the arguments used against 220 volts are equally wild. For instance:—"The 220-volt lamps are of low efficiency, requiring 55 to 80 watts when new, as against 45 to 60 watts for 110-volt lamps;" while we are told by the writer of the paper that "the 220-volt lamps of two prominent makers give nearly 20 C.P., although marked 16 C.P.," in which case the efficiency would be about the same. In England, at any rate, the difference in efficiency is not sufficient to be serious, hence all the arguments used by those who supply on a "flat rate" system of charge against the high voltage lamp does not apply, more particularly as the English practice is to charge chiefly by meter.

The objection urged against 220-volt lamps that "the filaments, being so slender, they cannot be used in a horizontal or inclined position without great risk of the filament drooping over and touching the glass bulb, thus breaking the globe," depends upon the make of lamp, and nearly all the later varieties provide some means of holding the filament in position, or else double filaments are used in series.

The same objection applies, but to a less extent, to 110-volt lamps. The question is, how often it is requisite or necessary to place lamps in a horizontal position?

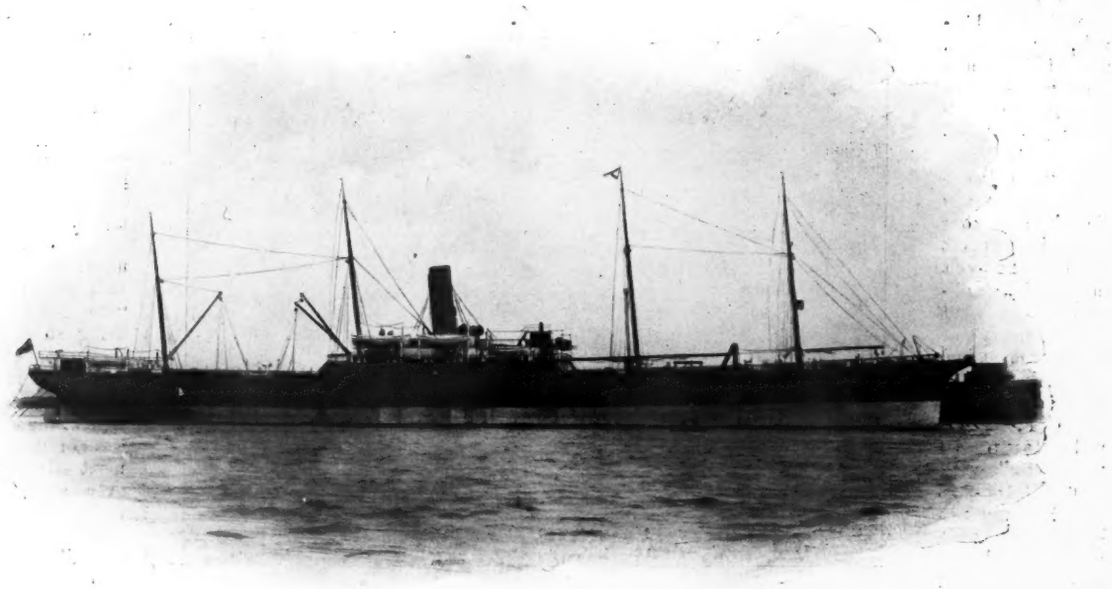
Other objections based upon the assumption of a considerably lower efficiency and the gradual increase in current taken are: "The unproductive load becomes greater if charging by the lamp hour or flat rate by the month," or "the load quickly increases beyond the capacity of the plant." "The lines will have a larger drop than calculated, hence the watts lost on the line will be greater." All "the lines must be larger . . . . thus losing a considerable benefit from the higher voltage." There are further arguments that the dynamo and engine must be larger *for the same lamp capacity* (italics ours), increasing first cost 10 to 20 per cent. greater consumption of coal. Even assuming that American 220-volt lamps are as bad as represented, it is surely far more satisfactory to both supply company and consumer that the consumption should be registered by meter in watt-hours, save in exceptional cases. The arguments adduced, however, seem to point to the fact that American methods are to the English mind somewhat crude, and that no provision whatever is made for extension in either plant or mains.

Prof. Shepardson, after quoting the various statements for

and against each system, says, "The writer disclaims all responsibility for the truth of the arguments detailed above, but gives them as those used by the advocates of the different systems. He believes they are *all* (italics ours) true, as far as they go, but his experience does not fully cover arguments 8 and 10 for the 220-volt system, or arguments 23 and 24 against."

Nos. 8 and 10 state that the 220-volt lamps do not blacken so much as 110-volt lamps, and customers, being better satisfied, take more lamps. Nos. 23 and 24 against refer to 220-volt enclosed arcs, and states that they are not so satisfactory "since the current is so small that the largest part of the light comes from the arc rather than from the carbons, thus making a violet tinge that is not agreeable." An arc lamp in which the light is produced chiefly by the arc would be an interesting study as a source of light, and, curiously enough, Lieut. Francis A. Badt, in an address before the North-Western Electrical Association, Milwaukee, in January of this year, advocated the connecting of enclosed arc lamps across the 500-volt mains for railway purposes.

Unfortunately for Prof. Shepardson's belief in the truth of all the arguments given, they are in some cases contradictory. The paper is, however, of considerable interest in many respects. The writer's views, as far as may be judged, are favourable towards the alternating system.



The Cable Ship "Anglia."

For some unknown reason, the writer appears to have overlooked the fact that all the arguments in favour of the *220-volt lamp*—as distinct from the 220-volt two-wire system—apply equally to either the three-wire, five-wire, or high tension system, and cannot be claimed by the two-wire system alone, as is attempted in the paper, while the ONLY arguments used which actually apply to the *system* as distinct from the lamp, are 11 and 12, viz.: "The wiring is simpler," and "there is no trouble from unbalanced load," and even these do not apply when comparing with high tension alternating.

Obviously, if the 220-volt lamp is an advantage to one system, it is of equal advantage, as far as the distributors are concerned, to all systems, and may be made use of on three or five-wire systems, by simply doubling the pressure on the outers, as has been done in England in several cases.

THE TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY'S TWIN SCREW CABLE SHIP "ANGLIA."

The trial trip of this ship took place on September 24th between Barrow and Liverpool North West Lightship. The distance on the two journeys, going and returning, was 60 knots, resulting in an average speed of 13·5 knots per hour.

The builders, Messrs. Vickers, Sons, and Maxim, of Barrow, were represented by Mr. A. Adamson, director. Mr. W. Shuter, managing director, Mr. F. R. Lucas, the engineer-in-chief, Captain W. R. Cato, and Mr. C. Crook, were on behalf of the Telegraph Construction Company, together with Mr. G. Scott, the naval architect of the vessel.

The principal dimensions of the ship are as follows: Length, 467 feet overall; breadth, moulded, 54 feet; depth, moulded from top of keel to spar deck, 36 feet. She has a double bottom, 4 feet 3 inches high, and water ballast capacity of 1,400 tons. Fully loaded to Suez Canal draught she can carry 8,620 tons dead weight. There are four pole steel masts fitted with derricks.

The anchor gear is of the most modern kind, and the anchors of the stockless pattern. The steam steering engine is carried on the tiller, thus doing away with all chains, and controlled by a telemotor from the bridge. The electric lighting of the ship is in duplicate, the dynamos are coupled direct to the engines, and the light leads are protected in steel insulated tubes.

Amidships, under the bridge deck, is the dining saloon, and sleeping rooms for the staff and officers of the ship, together with kitchen, pantry, bath rooms, and other offices. The spar deck, bridge deck, and navigating bridge are laid with East India teak planking. The main engines are two sets of the triple-expansion inverted direct-acting type, having cylinders 22, 35½, and 61 inches diameter respectively, with a stroke of 48 inches.

There are four single-ended steel boilers 16 feet 4 inches diameter, 10 feet 10 inches long, with four furnaces each. The working pressure is 195 lbs. per square inch. The I.H.P. on the trial tip was 4,000. The propellers are four-bladed, of bronze.

After the trial trip, which was most satisfactory in every respect, the *Anglia* was handed over to the command of Captain W. R. Cato, who then brought her round to the Thames. She is now moored off the company's works at Greenwich, to be fitted with four cable tanks, her paying out and picking up machinery, &c. The machinery is to be of the latest construction and design.

The tanks and machinery have been built at Greenwich by the Telegraph Construction Company, and include many improvements, dictated by the experience of the company's engineer and staff.

Her first voyage will be laying a cable for the Eastern Telegraph Company, from Gibraltar to Malta and Alexandria, on which she will shortly be despatched, with a total length of 2,181 miles, weighing some 4,650 tons.

ELECTRIC LIGHTING NOTES.

(*Continued from page* 560.)

Stafford.—The Free Library, reading and reference rooms are to be lighted electrically. A sub-committee has been round the town, and decided upon increases in the number of lamps in various parts.

Stockton.—It is expected that the work of laying the new electric plant for the town of Stockton will soon be in hand, and that within 12 months the borough will be lighted throughout by electricity. At a meeting of the Town Council last week the Gas Committee recommended that the town clerk be instructed to inform the Brush Electrical Engineering Company that the sanction of the Local Government Board had been obtained for the loan required for the installation, and that their tender, as amended and approved by the engineer, was accepted subject to a formal contract being signed, the position of the site being reserved for the decision of the Corporation. The recommendation was adopted.

Sunderland.—For a couple of hours on Sunday night the electric light was extinguished in the principal streets. The facts are as follows:—There was a breakdown of a large concentric cable on Sunday night at 6.10, which prevented the direct current supply being re-started until 8.20. An attempt was made to clear the fault by "burning out," but this was unsuccessful (of course it was not known that it *was* a concentric cable). On examination it was found that a length of some 50 yards had been burnt out, so it will be evident the short was a bad one, starting in one place and apparently spreading backwards. It is strange that no intimation was given at the station beforehand, the station ammeters standing at zero during all Sunday afternoon. The alternating (residential) district was not affected.

Swinton.—The Swinton and Pendlebury Urban District Council have decided to apply for a provisional order for the supply of electrical energy for traction and public lighting purposes. The Council have called in a consulting engineer to advise them as to the probable cost and best sites for the installation.

Teignmouth.—At last week's District Council meeting the Gas Committee recommended that the surveyor prepare a report and an estimate of the approximate cost of lighting Teignmouth and Shaldon with electricity. The surveyor said he had undertaken to supply a rough estimate to the Gas Committee. When detailed plans had to be prepared an electrical engineer would have to be engaged.

Tottenham.—At the District Council meeting last week, the General Purposes Committee recommended that the Council applied to the Board of Trade for a provisional order to supply electricity within the district, and that the applications that had been made by other parties be opposed. The recommendation was passed.

Tunbridge Wells.—At last week's Council meeting, Councillor T. Ashby Wood, as chairman of the Electric Light Committee, reported the gradual extension and improvement of the street lighting within the borough boundary, and Alderman Cronk expressed the opinion that the exceptional amount expended on the lighting of Mount Ephraim was not justified after the close of the Tunbridge Wells season. Alderman Clifford and Councillors Robinson, Strange, and Howis all defended the need of the full lighting of Mount Ephraim by night. The report was adopted.

A Local Government Board inquiry with respect to the additional loan of £15,000 for electric lighting extensions was held on Tuesday, 4th inst. There was no opposition. The Lighting Committee and many other Councillors were present. The Inspector, after examining the town clerk (Mr. W. C. Cripps) and the electrical engineer (Mr. Horace Boot), visited the works and sub-stations, and it was understood he would report favourably. On the following day (5th inst.) the Council decided to light St. John's Road as far as Skinner's School, and London Road as far as the Brighton Railway Station, with 13 more arc lamps. Considerable discussion arose with reference to the extra expense incurred by substituting arc lamps for "gas glimmers," but in the end it was carried by a very large majority, that it was well worth the expense to light the town properly. In the course of his statement the town clerk said that at the initial stage of the electric lighting scheme Mr. Preece had advised a tentative outlay of £13,000, which would meet the expenses of 4,000 glow and 35 arc lamps. There had been an increase of from 13,000 to 20,000 glow lamps. The gross revenue last year was £4,208, and this year £5,694. The gross profit to March 23rd, 1897, was 10 per cent. At the end of March, 1898, the number of consumers was 350, and the number of streets illuminated was now 57. The mileage of cable was 18 in 1897, and there were 30 miles at present. In view of this extension it was now proposed to borrow another £15,000 for the work of extension in various additional streets of Tunbridge Wells and suburbs. The light was now a source of considerable municipal profit. From 1897 to 1898 the electric light profits had been £1,347 17s.

Walsall.—At the Council meeting on 10th inst., the Electric Lighting Committee recommended that the salary of the electrical engineer be increased from £200 to £300 a year, and that electric lamps be substituted for the incandescent gas lamps in Digbeth and High Street at a cost of £188. They also recommended that a sum of £400 be included in the next borough rate estimate to cover the loss on the Electric Lighting Department. The report was adopted.

Warrington.—A Committee has approved of the plans of the proposed electric light station, and Mr. A. H. Preece has been appointed consulting engineer to prepare a scheme for lighting the town.

Wath.—At the last meeting of the Wath Urban Council notice was given of an intention to apply for a provisional order to light that town with the electric light.

Whitefield.—The District Council is approaching the Manchester Corporation to invite from them an offer to supply the district with electric light together with particulars of cost.

Whitehaven.—The Harbour Commissioners have just entered into a contract with the Whitehaven Corporation for the lighting of the harbour by electricity for a term of five years.

Wolverhampton.—At the monthly meeting of the Town Council on Monday evening, the Lighting Committee presented a detailed report upon the proposed extensions of the electric lighting system in the borough in order to cope with the increasing demand for the illuminant. These extensions were briefly referred to in the Electrical Review of September 30th, and their estimated cost is £29,740. The Committee state that at the present rate of progress it will be necessary before next winter to construct two more sub-stations of two transformers each in the St. James's Square and Church Street districts, and also at or about Clark Street (Tettenhall Road) and on the Dudley Road. Under the existing system all the current is sent from the generating station to the Town Hall switching system, whence it is distributed to the various sub-stations. The Committee propose to change this system—(1) by providing a low pressure supply direct to the St. James's district; and (2) by establishing elsewhere a three-wire system of supply with two different pressures. The Committee also propose that another trunk main should be laid from the generating station to the Town Hall, believing that as the system has grown so much it is undesirable that the whole of the supply should depend upon the integrity of one trunk wire. Last winter the trunk main was loaded to 66 per cent. of its full capacity, and the anticipated increase of 50 per cent. next winter will exceed the capacity. The Committee have also in view the possibility of a supply of energy being required for tramway traction. The change from the present uniform system to the three-wire system will be made gradually, extending altogether over two years. The result will be that the Town Hall transformers will cease to be required and will be removed to the new sub-stations in the outer portions of the borough. In view of the changed pressure it will be necessary to inspect the wiring on consumers' premises, and, probably, to re-wire at the Corporation's expense, and to supply gratis new lamps and fittings suitable for the increased pressure. The proposed combination of the high and low tension systems will reduce the risk of breakdown. The following are the principal items of expenditure now projected:—Extension, &c., of generating station, £960; new battery room, £2,000; two steam boilers, £1,060; two steam dynamo sets, £4,800; a 260-cell battery, £3,000; a charging set, £1,000; additional fittings, £1,200; new trunk mains, £3,950; new branch mains, £2,306; cost of partial conversion to the three-wire system, £290; cost of new sub-station at the Exchange Hall, £1,490; Clark Street sub-station and mains extension, £3,300; extension of street lighting to Halfway House, £300. Other items bring the total up to £29,740. The adoption of the report was moved by the Chairman of the Committee, Ald. C. T. Mander, and Councillor Johnson seconded the motion. The report was adopted.

Worcester.—The City Council will join other municipal authorities in contesting Mr. Martin Rucker's claims for infringement of the Zipernowski patent.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Blackburn.—The Town Council has resolved that, immediately electric traction is substituted for the existing horse system, the fare for all journeys within the borough shall be reduced to one penny.

Brighton.—At a meeting of the Council on the 6th inst. the General Purposes Committee reported the receipt of a letter from Councillor Carden suggesting that the Council should consider the question of themselves constructing and maintaining a service of electric trams from the top of North Street to the "Seven Dials," Dyke Road, and also a similar service from the centre of the town to the Queen's Park district. It was resolved that the consideration of the matter be deferred. Councillor Carden said he did not see why the fact that the committee were receiving applications from companies should compel them to defer the question of establishing tramways themselves. The Dyke Road district, among others, was much in need of means of transit, and he did not see why the Council could not embark experimentally on a small piece of line such as he had suggested. Councillor Broadbridge said he hoped the committee would consider the disadvantages of having tramways in the borough. He looked rather to the development of traffic by motor carriages. Councillor Halliwell referred to Coventry as a place where electric tramways were taken through narrow streets. The Mayor (Sir John Blaker), in reply to a question, said they had not power to run electric trams, but if they wanted it they could get

it. In the course of the discussion which followed, Councillor Buckwell said he should be sorry to see a tramline on the front, but he was pleased to see so many members in favour of tramways in the outlying districts. The Mayor hoped the discussion would now drop. They were inundated with applications from companies, and further debate might prejudice their position. He was sure it was the opinion of the Council that if tramways were to be introduced it should be by the Council themselves.

Coatbridge and Airdrie.—At Airdrie Town Council on 6th inst. the clerk read a letter received by the town clerk of Coatbridge enclosing copy of a letter from the Parliamentary solicitors on the tramway question, stating that the Board of Trade will hold an inquiry into the application for a light railway tramway for Airdrie and Coatbridge at their offices in London, on 27th inst., when an opportunity would be given to the objectors, or their agents, of being heard in support of their objections. The Provost explained that at the last joint meeting of the committees it was arranged to oppose the British Electric Traction Company's application, seeing that they now withdrew from the agreement to give half-mile stages and half-penny fares. The Council unanimously approved of this, and left to the committee to arrange for the opposition to be stated at the inquiry.

Dublin.—The Dublin Tramways Company's large new electric power station at Ringsend is being pushed forward as quickly as possible.

Halifax.—At last week's Town Council meeting, in reply to Mr. Wheater White, Alderman Booth (chairman of the Tramways Committee) said that until they procured additional cars they could not accelerate the service to King Cross or Highroad Well. Of the ten cars which comprised their present equipment, three were just now disabled. Four new cars were expected shortly. The following contracts were accepted:—Messrs. F. Pearn & Co., Limited, Manchester, to supply a pipe-facing machine for £214; Messrs. C. A. Parsons & Co., Newcastle, for the supply and erection of two steam turbine dynamos at £4,400; Messrs. Joseph Bancroft & Co., for slaters' work in the erection of a new retort and purifying house, £579; for the supply of car trucks and electrical equipment, the British Thomson-Houston Company, Limited, £3,419 16s. 9d.; and the Westinghouse Electric Company, Limited, £3,450 4s. It was decided to authorise the Tramways Committee to erect a tramway depôt on land at the junction of Shaw Hill and Free School Lane, at an estimated cost of £4,200.

Hamilton, Motherwell, and Wishaw.—According to the *Hamilton Advertiser*, the proposed electric tramway for this district is likely to be proceeded with shortly, and will be designated "The Hamilton, Motherwell, and Wishaw Tramway Company." The route will be from Stonefield Road, Blantyre, through Burnbank, to Hamilton, along Almada Street and Cadzow Street, down Castle Street to the Edinburgh Road, thence to Motherwell, up Windmillhill Road, and on to Wishaw, by way of Flemington, Craigneuk, and Shieldmuir. Negotiations for the appointment of an engineer in connection with the work are in progress.

Hawaii—Addressing the shareholders of the Hawaiian Tramways Company at Cannon Street Hotel on Tuesday, Col. Davidson, the chairman, said that with reference to the change of motive power to electricity, the matter had now become one of great urgency. About five or six years ago they obtained power to use electricity, but it had not then developed as it had since done. The expense of making the change would at the time have been very great, while the profits on the capital which they had already expended had been disappointingly small. Since then a tramway company to use mechanical traction, called the Rapid Transit Company, in direct competition with this company, had been sanctioned by the Hawaiian Legislature; it did this at the very last sitting it held. The directors opposed this Bill, and presented one on behalf of the company to extend their line and use electricity. Simply because they were an English company, however, their Bill was shelved. When they endeavoured to obtain capital in Honolulu to adopt electric power, which was wanted by the people there, they could not obtain a cent. While mechanical traction was in its experimental stage, the directors did not consider it advisable to recommend the shareholders to subscribe the capital to make an alteration, which at that time had a doubtful future. Now that the installation was much less expensive, and that cars could be bought to suit their light rails, the case was different; but they were met by opposition. The English company, which had spent £95,000 in constructing the tramway, and which had run the industry at very small profits for nearly 10 years, was not to be allowed to make the alteration, but the concession must be handed over to a new local company. That was what the Hawaiians said. The directors, however, maintained that the right conferred upon the company to use electricity had never lapsed, and they had perfect confidence in the integrity of the Government of the United States of America to confirm and uphold the rights of English investors in the Hawaiian Islands, which had recently been annexed to that great country. They had, therefore, begun to carry out an electric installation from Palama towards the town, and should this prove successful, they might have to ask the shareholders to help them to continue the alteration.

Hessle-Hull.—On 5th inst. at a meeting of the Hull Tramways Committee a deputation attended on behalf of the promoters of a company who propose constructing an electric tramway from Hessle to connect with the new system at Hull.

Kidderminster and Stourport.—The *London Gazette* for 7th inst. contains a copy of the bye-laws and regulations made by the Kidderminster and Stourport Electric Tramway Company. They are signed by Messrs. J. S. Raworth and E. Garcke, directors, and Mr. H. S. Hodgson, secretary.

Leeds.—The City Council on 4th inst. went into committee to discuss two resolutions passed by the Parliamentary Committee as follows:—"That the Council be recommended to promote a Bill in Parliament for powers to extend the tramway of the Corporation from the city boundary to the boundary of the city of Bradford;" and "that the town clerk be instructed to apply for the consent of the West Riding County Council, as the road authority, and the Urban District Councils of Pudsey, Farsley, and Calverley to the proposed tramway extension." The resolutions were carried by 29 votes to 17.

Light Railways.—The Board of Trade has issued rules and scales of costs relating to the allowance and taxation as against a light railway company of all costs and charges of a claimant in an arbitration.

Madrid.—The official trial of the new electric trolley tramways in Madrid took place on the 3rd inst. with successful results.

Manchester.—The Tramways Sub-committee have prepared their report on the electric tramway systems of Dublin, Glasgow, Hamburg, &c., and they recommend the immediate purchase of a site for a power station and the preparation of the track for electricity. They recommend double-decker cars for certain routes, and single-deckers on others for experimental purposes. The various matters come before the Tramways Committee's meeting next Monday.

Middlesbrough.—Mr. Clifton Robinson has been laying before the Streets Committee the proposals of the Imperial Tramways Company to extend their electric tramlines to the north side of the town. The company will receive the same assistance as was given on a former occasion.

Oldham.—The Chadderton District Council cannot come to a decision as to the proposal of the Oldham Corporation *re* running electric trams through their district, as the information provided is insufficient.

As the Middleton light electric railway scheme is considered likely to interfere with the full development of the Oldham Corporation electric lighting and power undertaking, the Surveyor's Committee has just formulated a list of objections to the powers sought by the promoters. The Oldham Corporation itself, as already stated, has a tramway scheme in hand, and this is one of the arguments used by the Surveyor's Committee.

Pembroke.—The Commissioners have written to the Dublin United Tramways Company stating that, provided the Board of Trade also approve, the Commissioners will permit the company to construct, for the purposes of the Dublin United Tramways Electrical Power Act, 1897, in part of Upper Baggot Street, Waterloo Road, Morehampton Road, Donnybrook Road, Haddington Road, Stillorgan Road, Sandford Road, Clonskeagh Road, Bath Avenue, London Bridge Road, Tritonville Road, Seafort Avenue, Strand Road, Gilford Road, Sandymount Road, and Newgrove Avenue, the tramway electric equipment as shown in statement submitted. The Commissioners will not, however, approve of the form of manholes and street boxes, with the ventilation and drainage of which the Board of Trade are not satisfied. With respect to the posts, the road authority, on the recommendation of their surveyor, have determined to have span wire posts on Tritonville Road.

Portsmouth.—An impression having got abroad that the Tramways Company is doing all that it can to hamper the Corporation in respect to the acquisition of the lines under the provisions of an Act passed last session, the manager of the former, Mr. A. W. White, J.P., has addressed a letter to the town clerk stating that, anticipating the adoption of electric traction, when the company commenced to relay the lines at Southsea, they were anxious to avoid waste of money by the work having to be pulled up and reconstructed, and he made an offer that if the Corporation would nominate a practical man to supervise the relaying and copper-bonding of the rails the company would employ and pay him. Since then he (Mr. White) had written to the town clerk several times offering to make any alteration or addition that might be considered desirable, and at the same time suggested some which he knew to be advisable. "The directors have resolved" (Mr. White continued) "that they cannot further delay the relaying of the worn portions of the line, and the work will be proceeded with forthwith. The rails have arrived, and we shall commence the North End and Cosham section in a few days; but we are still desirous to prevent ultimate waste of money, and I again beg to say that we shall be glad to do anything reasonable in our power to meet the after requirements of the Corporation. The company has every reason to be satisfied with the Corporation Bill, and as there can be no further reason for antagonism, I shall be very glad to afford any assistance in my power to prevent the committee having to grope in the dark for facts, or act upon guess figures."

The Potteries.—The Newcastle-under-Lyme Town Council has received a letter from the Board of Trade intimating that they had extended the time for the completion of the work under the Potteries Extension Tramways Order, 1896, for six months, with a warning to the promoters as to the difficulty there would be in granting any further extension.

Stockton.—The Imperial Tramways Company have informed the Corporation that they intend extending their electrical tram system to Eaglescliffe from Stockton, and have asked the Corporation's views. The company is to submit plans.

Wolverhampton.—In view of the decision of the Wolverhampton Town Council to purchase the tramways within the borough from the Tramways Company, the Tramways Committee of the Corporation presented to the meeting of the Town Council on Monday an elaborate report setting forth their scheme for improving and extending the tramway system, and also recommending the Council to apply to Parliament for the necessary powers. The present tramlines are to be greatly extended; a number of new connecting lines are to be laid down, and the whole town and district is to be thoroughly intersected; whilst powers are to be obtained in order to secure certain lines beyond the borough boundary. Anticipating that no objection will be raised to the proposed purchase, the Committee think it very desirable that they should be armed with all the necessary powers to work the tramways when acquired, if such a course be found to be desirable, and to reconstruct and extend the existing tramways. To delay taking action in this respect until the tramways have actually been acquired might, the Committee say, prove a source of great inconvenience and delay. In submitting, therefore, the recommendations contained in the report, it must, they say, be distinctly understood that the powers sought are entirely of a permissive character, and that even when obtained need not be acted upon if the Council should so decide. There will, however, be inserted in the proposed Bill a time limit within which such alterations and extensions must be completed, or in default abandoned. If electric traction be hereafter decided upon it will be necessary, according to the opinion of the expert (Mr. W. H. Beattie, C.E., of Edinburgh), whom the Committee have consulted to reconstruct the existing lines. The Committee, on the advice of their expert, propose to retain the existing gauge of 4 feet 8½ inches. Ald. C. T. Mander (chairman of the Tramways Committee) moved the confirmation of the report of the Committee, and, after a brief discussion and suggestions from members of the Council it was adopted.

TELEGRAPH AND TELEPHONE NOTES.

The Glasgow Telephone License.—At last week's meeting of the Glasgow Corporation Mr. Alexander moved the adoption of the minutes of the Finance Committee. He said that they had applied for a telephone license in 1893, and again last year for a license for the whole Glasgow telephone area. They had also had no fewer than three inquiries. Their only object in gaining a license was in order to give the citizens of Glasgow a cheap and efficient telephone service, and also that the Corporation might have control of their own streets. Now they had the promise of a license from the Postmaster-General on obtaining Parliamentary power to go on to the year 1911. The City of Glasgow was not afraid to undertake any improvement, and they had no fear that at the end of 1911 their system would be so good that the Government would be compelled to buy it up. He moved that the matter be remitted to the Parliamentary Bills Committee in order to frame a Bill to get the power for the license they had so long sought after. Bailie W. F. Anderson seconded. Mr. Dickson said that an important question was whether compensation would be given to the Corporation for its outlay, and what the cost would be. There would be a very large sum of money spent, and there would no doubt be considerable contention between the Corporation and the company. Mr. Alexander said that the cost would not be very great. To form an exchange the same as the present one in Glasgow the expense would at first be only £100,000. He had confidence that at the end of 1911 the Government would buy them up; in fact, the Government had said so. Mr. Gray said that this was only the preliminary warrant for the Parliamentary notices, and all the points would be carefully considered by the Committee and reported to the Town Council. Bailie Dick thought the Corporation had been kept in the dark too much by the Committee. They should have fuller information on the question of cost before they incurred the expense of promoting a Bill. There being no amendment the minutes were approved.

Manchester Telephones.—It appears to be the intention of the Corporation to allow the proposed new telephone company to get its license from the Post Office if it can; but, if not, then to apply for a municipal license.

Newcastle Telephones.—The Town Council on Wednesday had a discussion on the question of municipal telephones, Glasgow affording a text.

Side Lights on Cable Routes.—In one of the leading Australian papers, the *Melbourne Argus*, a considerable amount of space has been devoted in the issues of August 26th and 30th to the proposed Pacific cable. We made reference to these last week, and pointed out that the information offered was simply a rehash of the numerous erroneous and misleading statements which have been so liberally offered for colonial consumption by those interested. We have so frequently exposed the fallacies and inaccuracies which have been so often and so skilfully advanced, that we do not care to devote further space to going over this ground again at present. An element of novelty has, however, been introduced into the matter in a further article published, as if by an afterthought, in the *Melbourne Argus* of the 6th ult. Here, in a column or so of matter relating to the Cape-Australia cable (with which we have already dealt), we find the following: "During the discussion on the Pacific scheme it was frequently suggested that the Eastern Extension Company might put up rates on the expiration of the Government subsidies in 1899, but, of course, all possibility of this would cease were the Cape route adopted. In any case it is hardly likely that a company which controls nearly one-half the cable mileage of the world, viz., 75,000 nautical miles out of a total of 165,000, would damage either its own reputation or the interests of its shareholders by any such suicidal act. As Mr. P. B. Walker, secretary of telegraphs in New South Wales, points out in one of his reports, no attempt was made by the cable company to raise the rates when the New Zealand and New South Wales Governments declined to continue the subsidy on that line." The first part of this statement does not appeal to our recollection, although we have followed the discussion closely. The idea has possibly arisen in the mind of the writer owing to the fact that the Eastern Extension Company have not replied to the inquiries urgently made by the Colonial Governments as to whether they proposed to reduce the existing tariff on the expiry next year of the annual subsidy (£32,400) which has been paid to the company by the Colonial Governments for the last 19 years. This seems all the more probable in view of the suggestion in this paragraph that "all possibility of this would cease were the Cape route adopted." As regards the latter portion of the statement, viz., that "no attempts were made by the cable company to raise the rates," &c., this statement is, if possible, still more inaccurate and misleading than the rest of the information given in these articles. The editor of the *Melbourne Argus*, who writes with assumption of minute knowledge, should refer to a telegram, dated September 20th, 1886, addressed to Sir Julius Vogel, then representing the New Zealand Government, by the late Sir John Pender, then chairman of the Eastern Extension Company, who, referring to the subject mentioned in the above extract from the *Argus*, wires: "The company have done everything possible to conciliate your Government and to meet the requirements of the telegraphing public, and if our guarantee proposal had been accepted it would have given the public a cheaper tariff than it is possible to obtain by any other means without entailing considerable expenditure on the colony. Under the circumstances, however, the company have no alternative but to raise the tariff for inter-colonial telegrams from October 1st to 10s. per ten words and 1s. for every additional word, in order to recoup the loss of the subsidy." This gives a flat contradiction to the statement we are dealing with, and, as a matter of fact, the tariff actually *was* raised over the cable between New Zealand and New South Wales. Having nailed this statement to the counter, there is little in the article worth further attention. It may perhaps be an indiscretion to suggest to the editor of the *Melbourne Argus* that in matters connected with the Eastern Extension Cable Company he might apply to Mr. W. Warren, the manager of that company in Australasia, to have his information verified. In the article we refer to, and which is published as an editorial, we find a table purporting to give the sub division among the various companies and governments concerned of the rate per word received for telegrams from Australia to London. It is curious to find in this schedule of proportions that the division of the cable route on the English side of India is described in this Australian editorial as "cis-Indian." This would have been described as *ultra-Indian* had the table above referred to, and which appears as part of the article, been really drawn up in Australia, instead of having been supplied, as we are justified in believing, from some (apparently) competent source in London. We can only inquire of ourselves how much more of the information we have proven to be misleading springs from the same source.

The Telegraph Wire Export Trade.—The fluctuating character of the export trade of this country in telegraph wire and apparatus connected therewith is well shown by the figures which are now available for September last. These show that during that month the value only amounted to £35,411 as compared with no less than £265,501 in the preceding month, and £46,127 in September last year. Notwithstanding this shrinkage, the shipments for the year to date are well in advance of those of 1897, the value of the exports for the nine months ending with September being returned at £847,408, as against only £746,875 in the first nine months of last year.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies—		
St. Lucia-St. Vincent ...	Sept. 24th, 1898 ...	Oct. 7th, 1898.
St. Vincent-Grenada ...	Sept. 24th, 1898 ...	Oct. 7th, 1898.
Amazon Company's cable—		
Cable beyond Gurupa ...	June 8th, 1898 ...	...
Bolama-Bissao	June 31st, 1898 ...	...
Perim-Assab	Sept. 13th, 1898 ...	...
Landlines.		
Saigon-Bangkok	Oct. 6th, 1898 ...	Oct. 6th, 1898.
" "	Oct. 7th, 1898 ...	Oct. 7th, 1898.
Indo-European Company's lines—		
Tauris-Teheran ...	Oct. 8th, 1898 ...	Oct. 8th, 1898.

CONTRACTS OPEN AND CLOSED.

OPEN.

Belgium.—October 27th. The municipal authorities of Ghent are inviting tenders until October 27th for an installation of

electric lighting in the new Flemish theatre in that town. Tenders to L'Hotel de Ville, Ghent, Belgium, from whence particulars may be obtained.

Burton-on-Trent.—October 27th. The Corporation wants tenders for the supply, construction, and erection of a 250-kilowatt alternator and engine, complete with all accessories. Particulars from Mr. F. L. Ramsden, manager and engineer, Gas and Electric Light Works, Burton-upon-Trent.

Bury.—October 26th. The Corporation wants tenders for the wiring of the public baths, St. Marie's Place, Bury. See our "Official Notices" this week for further particulars.

Edmonton.—October 25th. The Board of Guardians are inviting tenders for the supply and erection of engines and dynamos, condenser, pipe work, wiring for 600 lamps, switchboard, battery, &c. Particulars and specifications at the office of the solicitor and clerk. See our "Official Notices" this week.

France.—October 22nd. The French naval authorities in Paris are inviting tenders until the 22nd inst. for the supply of three steam dynamos giving 600 amperes at 82 volts, required in connection with the electrical installation on board the new cruiser *Henri IV.*

France.—October 27th. Tenders are being invited until the 27th inst. by the French post and telegraph authorities in Paris for the supply of 40 tons of high conductivity copper wire. Tenders to be sent to Le Sous-Secretariat d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris, whence particulars may be obtained.

General Post Office.—October 25th. The G.P.O. is inviting tenders (*a*) for the supply of red fir telegraph poles, to be delivered in London, and at Northumberland Dock (River Tyne), West Hartlepool, Hull, or Grimsby; and (*b*) for creosoting the poles with 10 lbs. or 12 lbs. of creosote to the cubic foot, as may be directed. The poles to be felled during the winter of 1898-9. Forms of tender, containing all particulars, may be obtained on application to Mr. Chas. E. Stuart, controller of stores.

Ghent.—October 29th. The Ghent Municipal Council is inviting tenders for the installation of the electric light at a new theatre. The work, says *Daily Tenders and Contracts*, has to be completed by June 1st, 1899 (a fine being imposed for every additional day to completion), and maintained for 12 months. Labour clause. The contract includes the supply and delivery of 1,337 incandescent lamps, 20 arc lamps, &c. All expenses for registering, stamps, notices, &c., which are estimated to cost 130 francs, to be paid by the contractor. A deposit of 8,000 francs is required, on which 2 per cent. will be paid after 60 days. Specifications seen with, and plans obtained, on payment of 40 francs, from M. Le Sécrétaire Communal (A. De Bruycker), Gand, or at the office of the paper mentioned above. Tenders, on stamped paper, registered, addressed as directed, with a certificate of deposit, to be posted by October 27th. The tenders will be opened at 11 a.m. on October 29th.

Great Western Railway.—October 24th. The directors are inviting tenders for the supply of various stores for a year commencing December 1st, 1899. Among the items are telegraph instruments, apparatus, ironwork and tools, and drysalteries; copper wire, G P. wire, &c.; electric light carbons, and incandescent lamps; telegraph poles, &c., &c. Specifications, &c., from the offices of the Stores Superintendent, Swindon. For further particulars see our "Official Notices" October 7th.

Halifax.—October 25th. The Board of Guardians is inviting tenders for supplying and fixing at the new union hospital, Skircoat, Halifax, about 85 small electrical ventilating fans, for the Guardians. Specifications and particulars from Messrs. Shepherd and Watney, consulting engineers, 71, Albion Street, Leeds.

Kingston-upon-Hull.—October 27th. The Electric Lighting Committee invites tenders for the supply and erection of certain plant in connection with the electricity works, including high and low tension mains, casings, trench work, &c.; switchboard, continuous current rotary transformers, motor-generator, &c.; centrifugal pump, condenser (ejector type), steam pipes, &c. Electrical engineer, Mr. A. S. Barnard. See our "Official Notices" September 23rd for particulars.

Leigh.—October 14th. The Electricity Committee want tenders for the supply and erection of steam dynamos, switchboard, accumulators, mains, meters, overhead crane, water softener, &c., for the electricity scheme. Particulars from the engineer, Mr. John Foster, Leigh, Lancs. See our "Official Notices" September 23rd.

New South Wales.—October 17th. The New South Wales Government is, according to *Daily Tenders and Contracts*, inviting tenders for the supply for the Department of Posts and Telegraphs of a steam engine and dynamo, 218 tons galvanised iron wire, 90 tons copper wire, 70,000 porcelain insulators, 16,000 zinc cylinders, 16,000 lead ditto, 50 tons copper vitriol, 1,000 bottles ink for Morse instruments, 1,500 telephones, 1,000 batteries (Leclanché), 10,000 porous cylinders for same, 15,000 zinc ditto, 24 arc lamps, with 22,000 carbons, and 2,000 incandescent lamps. Further particulars, &c., obtained from, and tenders to, the Secretary, General Post Office, Sydney, N.S.W.

The Potteries.—October 22nd. The British Electric Traction Company, Limited, is inviting tenders for the overhead construction of the Potteries Extension Tramways. Specifications and particulars may be obtained from Mr. C. H. Gadsby, contract engineer to the company, at the company's offices, on deposit of £5 per set.

Southampton.—November 16th. The Committee of Visitors of the County Lunatic Asylum, Knowle, near Fareham, is inviting tenders for the supply of two engines and dynamos equal to an output of 24,000 watts each, together with all necessary washing machinery, lathe, drill, motors, lamp installations, &c., required in connection with the centralisation and increase of the light, heat, and power generating plant. See our "Official Notices" October 7th *re* specifications, plans, &c.

South Shields.—October 19th. The Corporation wants tenders for the supply and erection of vertical triple expansion engine, 800 I.H.P. or 1,000 I.H.P., with surface condenser; and an ironclad or inductor type alternator, 400 or 500 kw. Specifications, &c., from the borough electrical engineer's office, West Holborn. See our "Official Notices" October 7th.

Wakefield.—October 17th. Estimates are being invited for the various works necessary for a complete installation of electric lighting at the Wakefield Mechanic's Institution. Specifications, plans, &c., to be seen at the library of the Institution.

Warsaw.—The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul-General at Warsaw stating that the Municipal Council of that city invites tenders for the exploitation of the tramways of Warsaw under municipal control. Horse traction, says the *Times*, is at present in use, but it is intended to introduce electricity as soon as possible. Information as to the conditions can be obtained from the Magistrat de la Ville de Varsovie, Varsovie, Russie.

Wimbledon.—November 7th. The District Council is inviting tenders for the supply, delivery, and erection of transformers and accessories. Specifications, &c., from Mr. A. H. Preece, 39, Victoria Street, S.W. See our "Official Notices" this week.

CLOSED.

Brighton.—The Corporation has given a contract to Messrs. W. Cory & Son, Limited, for the supply of 1,500 to 2,000 tons of Powell Duffryn Aberaman Pit or other coal at £1 1s. 9d. per ton, for the electricity works.

Buxton.—On 7th inst. the Urban District Council accepted the tender of Messrs. Mather & Platt, Limited, amounting to £4,236, for the supply of electric plant, including spare parts and compound steam pumps, in connection with the scheme for lighting the town by electricity, of which Prof. Kennedy is the consulting engineer.

Halifax.—The Town Council has accepted tenders for electric tramway plant, &c. See under "Traction Notes."

NOTES

Planning Pipe Lines and Penstocks.—We have received an advance copy of a paper by F. M. F. Cazin on the above subject in the *Journal of the Franklin Institute.* It is a discussion on the question of the flow of water in pipes. The author suggests a new method of design. This consists in adapting the pipe everywhere to the pressure so as to permit the water to move "in unimpeded adaptation of its shape to the laws of gravitation." To effect this the diameters of pipes at any level of a pipe line may be decreased at the rate of the fourth root of the head above such level. Reduced to practice, an undulating pipe would be a series of successive taper lengths. The idea seems sound enough, and with careful design should conduce to economy, especially in these days of sheet pipe, which, we fancy, can be better manufactured to a gradual and slow taper than can a long line of cast-iron pipe. Obviously the difficulty of the new method is in the variation of the diameters from point to point, and it may be doubted if the economy will be so much as the author expects. In these days of water-power utilisation the idea is worthy of every consideration.

Phœnix Fire Office Rules.—The twenty-eighth edition of the Phœnix rules, drawn up by Mr. Musgrave Heaphy, for electric lighting, power, and heating installations, have just been issued. Mr. Heaphy draws attention to the fact that testing does not show up certain defects which may exist in the conductors, a point to which sufficient attention has not hitherto been directed.

An American Electric Light System.—The *American Electrician* describes the electric light system at Claremont, N.H., as being of particular interest as an example of the application of storage batteries. The plant is on the Sugar River, and a fall of 15 feet is available by means of a dam, which backs up the water about a mile and a half. The fall varies from 7½ to 16½ feet. The turbine drives a shaft at 70 revolutions per minute. This shaft is divided into three sections for convenience in cutting off power, and for coupling up to an auxiliary steam engine if required. There are two Edison bipolar dynamos, two boosters, and a battery of 134 cells, all connected on the three-wire system. During seasons of heavy load, the batteries and dynamos are connected directly in multiple. When the peak is passed, the voltage applied to the batteries is increased by the boosters. The day load is carried entirely by the batteries, and a constant service is secured by a six hours' run daily of the plant. The cells are chloride accumulators, with Manchester positives. Each cell rests in a wooden trough, supported on four grooved glass insulators, the insulators being filled with oil to stop creeping currents. The complete cell weighs 250 lbs. Acid of 1,200 Baume, kept at that by the addition of about one pint of water weekly. They have now worked two years, and show no deterioration. They are cleaned once a year. The charging rate is 50 amperes, and so is the discharging rate, though at times 100 amperes have been drawn. At 50 amperes the capacity is rated at 400 ampere-hours. The plant is looked on as an example of what may be expected from sound and well made accumulators.

What Shall We Do With Our Girls?—Can it be true that the male borough electrical engineer must look to his laurels, and that one of these fine days he may awake to find his occupation, like Othello's, gone? The "new woman" threatens to become his rival! How charmingly this appeals to our imaginative faculty! We are tempted to picture the plants at Manchester, Edinburgh, Brighton, and, for that matter, Bankside as well, under the control of a fair nymph duly qualified for membership in the Institution of Electrical Engineers. What a change there would be in the demeanour of some of our provincial town councillors who are now so complaining! What sweet music would reach the ears of the harassed and harassing contractor! There would be no naked conductors allowed upon the consumers' premises! But, there! we dare not carry the thought farther at present, and someone even whispers that it is not yet necessary. True it is that we cannot give the name of a lady holding such an appointment in this country at the moment, but there is one in America, for Mrs. Iva E. Tutt has put down a $50,000 installation for lighting the towns of Long Beach and San Pedro, California. This lady holds the majority of the stock, and runs the business. When the men are required to attend to the outside work Mrs. Tutt manages the station. The machinery was bought by her, and erected under her personal supervision, and her photo is duly recorded in the *Western Electrician*. What do the members of the Municipal Electrical Association and other electrical societies say to this? A jealous cynic, looking over our shoulder as we write, ventures to interpose: "What! our girls run our complicated electric lighting plants! Tutt, Tutt!"

Lighting the Side Streets of the City.—What has become of the long-promised report of the City electrical engineer and the Committee upon the lighting of the side streets of the City of London? A couple of years ago very complete experiments were made in various less important streets, but the results have not been made public. A question was asked at the Court of Common Council, but the reply was not at all satisfactory. Surely sufficient time has elapsed for the Streets Committee to make up its mind!

Windmills for Wormit.—In connection with the lighting of the village of Wormit, the *Dundee Courier* says that Mr. A. Stewart, Wormit, has erected a building in which he is to set up a plant for electric lighting, the firm engaged for this being the British Illuminating Company, Limited, Edinburgh, under whose engineer, Mr. J. C. Sleigh, the work will be carried out. Mr. Stewart proposes to use the wind as motive power, and he is confident that by the New Year he will have Wormit electrically lighted.

The Position of Draughtsmen.—The discussion on this subject in the *Engineer* produces nothing satisfactory. There are the old arguments on each side. One letter from an "Oppressed Draughtsman" is very evidently "writ sarkastic," for it details his troubles in regard to a hunting cog. Having got into trouble for omitting one in a long train of wheels, he put one later in a big shears gear, so that the shears jaw and eccentric came together, and there was a smash. The inference intended to be drawn is that all draughtsmen are not engineers. Others, again, fail at the commercial side, and never are able to contrive to pay. Obviously there are very many men who can make a drawing, but cannot design. It seems the fashion to pay these men small salaries, though, thanks to the A.S.E. and other unions, a mechanic who can only turn a nut is held to be as valuable as one who can originate and scheme methods of work. For a draughtsman who means to remain a draughtsman, a knowledge of commercial conditions is not necessary, further than acquiescence in the necessity of avoiding expensive work. Obviously the solution of the question is impossible on general lines, and we fear that in the future, as in the past, draughtsmen will need to work out their own salvation. They will find it difficult, simply because if they are worth anything, they constantly find themselves in hot water with the men who treat them as chattels, and if they are not particularly bright they will never get the pay of a mechanic, not being "'orny 'anded sons of toil." To be shut up in an office also deprives a man of any great chance of becoming known outside. An erector of machinery has a far better time and more freedom. He becomes accustomed to meeting his fellow man, and to business ways. No man should go into a drawing office unless he can see his way through it. Yet every engineer should know how to draw. Doubtless there is a good deal to be said on both sides of the question. There is nothing so aggravating as a draughtsman who requires to be led all through a job, and on whom no reliance can be placed as an engineer. There are many such men in the ranks of draughtsmen, and it is difficult to say how they ought to be employed, unless on any routine work. Original design is hopelessly beyond them, but the worst is, they cannot see for themselves that they are not engineers.

Fools and their Work are soon Parted!—A specimen of what stuff strikers are made has just occurred at Newington. It goes without saying that the contractors for the new Vestry electricity works' buildings are required to complete their contract with all possible speed. Progress has been delayed for the time being, however, because 25 out of the 31 men employed have struck work, the sole reason being, so for as we can understand, that one man worked too hard to please the others. He seems to have gone about his work in an honest and energetic fashion, and to have done his best for his employer. His fellow unionists objected to his getting up to his corner too quickly. He was at one end of the wall, and the other men had to level up to the work performed by him. As he got on too well for them they demanded that he should be discharged, although he, like themselves, was a unionist. As this was refused they struck work. Talk about tyrannical masters! The tyranny of lazy workmen who try to crush a man for no reason other than that he is trying to do his best, is hard to beat. Is this one of the advantages that trades unionism, as at present practised, brings to the working classes?

Shoreditch *cum* Blackheath.—We cannot at the moment place our hands upon the prospectus of the Blackheath and Greenwich District Electricity Company, but if our memory does not fail us, there were two notable features connected with the scheme. One was that the directorate was adorned by the person of Mr. Kershaw, of Shoreditch dust destructor fame, the other was the use of one of these destructors for steam raising. We wish to ask whether this doubtful appliance has now been tabooed by Mr. Kershaw himself, and whether that gentleman is yet able to supply us with the cost, all told, of labour for dealing with the Shoreditch refuse.

The Cost of Electric Driving.—Without doubt the first cost of an electrical driving plant is considerable. The *Engineer* broaches the subject with a view to point out that the first cost of electrical driving is prohibitive to many people. Under the old system, for example, if a man requires 300 H.P. it will cost him, say, £500, but if he goes in for electricity he will still need the £500 engine and the dynamo as well, and also separate motors, even though he will save the cost of shafts, pulleys, belts, and so on; but it is just here our contemporary makes a mistake. If he requires 300 H.P. by the old system, and this costs £500, he need not have a 300-H.P. engine under the new system. He ought to be able to save in both engine and boiler cost and in shafting also, and it is in the efficiency of power distribution that electricity scores. We doubt much economy of power in driving a cotton mill, for example, but we see a very large economy in driving a fan through 50 or 100 feet of wire in place of shafting. Everything depends on the factory, and we have before pointed out that the economy of electricity is not only in the mere saving in smaller engines, but comes in the building department also. Less heavy pillars and walls will suffice, and general simplicity is possible. Our contemporary uses, as a warning, the suggestion of one Mr. Painton, who suggests a steamboat driven by turbines and electro-motors. It rightly objects to this needless complication and weight, and cannot consider it an improvement on Parsons's direct connected propellers. Nor do we. We would never glibly recommend the placing of electrical machinery between a heat engine or other prime mover and its load, where this load is near by, unless such prime mover is of the unhandy type of the gas engine, incapable of rapid handling and reversal. There is perhaps good reason for warning against the too promiscuous and general employment of electrical power transmission. Too great urgency on the part of advocates of electricity has been undoubtedly exercised. In electrical *transmission* of energy it is too little remembered that it is necessary to italicise the word *transmission*, and that the longer distances over which this takes place, the better showing will electrical systems be able to make. In electricity, *per se*, there is no advantage at short ranges, and at long ranges there is no serious rival. The engineer's business is to select electric methods for such ranges as are suitable for its economical application.

Wireless Telegraphy.—Owing to their lease having expired at Madeira House, Bournemouth, the Wireless Telegraph Company have moved their installation from there to the Haven Hotel, Sandbanks, Poole, which is at the entrance to Poole Harbour. The same pole and instruments are used, but there is a rather diminished height there compared with what they had at Bournemouth. Notwithstanding this, however, we understand that the first message received was perfect, and since then all work has been entirely satisfactory. The total distance from the Needles Hotel to the Haven Hotel, at Poole, is 18 miles.

Personal.—Mr. H. M. Salmony asks us to notify that he has returned to town, and that all communications for him should be sent to Durham Lodge, St. Margaret's, Twickenham.

It may interest several of our readers to hear that Mr. J. E. Dane, who for the past eight years has been in the service of the Westminster Electric Supply Corporation (the last few years as chief inspector), has accepted an appointment as accredited agent for the Australian Jones Rock Drill Company, and sails for Melbourne on the 28th inst., per R.M.S. *Ophir*.

We understand that Mr. E. T. Ruthven Murray, borough electrical engineer at Worcester, has just been elected in a similar capacity to the Willesden Urban District Council. He will design a scheme.

Institution of Mechanical Engineers.—The opening meetings for the winter session will be held on 26th and 27th inst. Mr. W. Langdon will then read his paper dealing with the electric lighting and power installations of the Midland Railway Company.

Memorial to Prof. Clerk Maxwell.—It is proposed to place a memorial to Prof. James Clerk Maxwell in Corsock Parish Church, and half-guinea subscriptions are being invited by Rev. Geo. Sturrock, The Manse, Corsock, by Dalbeattie, N.B. Clerk Maxwell was very closely connected with this church throughout the whole of his life, at one time as an Elder, and that is the reason for the present proposal. Lord and Lady Kelvin have subscribed to the fund.

Presentations.—At Bolton on 5th inst. the workmen of the electrical department of Messrs. Dobson & Barlow, Limited, presented Mr. Joseph Platt, who has had charge of the electrical branch of the firm's business for the past seven years, with a set of drawing instruments, board, &c., and box of colours. A few other business friends presented him with a handsome walking stick. Mr. Platt is entering into partnership with Mr. H. Bleasdale, as electrical and mechanical engineer, at Albion Works, Central Street, Bolton.

On 1st inst. Mr. E. P. Grove, the resident engineer for the British Thomson-Houston Company, who laid down the electrical installation for the Middlesbrough, Stockton, and Thornaby tramways, was presented in the Palatine Hotel, Stockton, with a handsome testimonial from the staff and workmen of the British Thomson-Houston Company as a token of esteem, on the completion of the plant. The presentation, which was subscribed for by the staff and friends in Stockton and Middlesbrough, consisted of a very handsome silver tea and coffee service.

Failure of the City Supply.—On Friday evening last, about 6 p.m., there was a failure for 20 minutes of the electric supply in the City of London. The actual cause of the failure was that two of the Brush machines at Bankside, recently fitted with Ferranti coils, failed simultaneously, one coil in each machine having apparently short circuited in one turn, and as six machines were then supplying the load, the loss of two of these machines so suddenly overloaded the remaining four machines that they refused to keep up to speed and came out of step, thus necessitating re-synchronising. Before being put on the load the machines had stood most severe tests. The interruption affected only a portion of the district (Fleet Street and the neighbourhood), as the City company's plant is divided and runs in separate districts.

The Jubilee of Schuckert & Co.—The extensive electrical engineering works of Messrs. Schuckert & Co., of Nuremberg, were idle on Saturday last, the men, who now number close on 5,000, being given a holiday in commemoration of the completion of the 25th year of the existence of the firm. We congratulate Messrs. Schuckert, and hope that their 5,000 employés may increase to 10,000 within the next 25 years.

Glasgow Electric Tramways.—The Springburn electric trolley tramway was successfully inaugurated yesterday. Public running commenced in the afternoon.

Electric Shock Fatality.—Through grasping an electric lighting wire while at work in the Leven Shipyard, Dumbarton, on Monday night, a labourer named Connolly received a shock, and was killed instantaneously.

Dr. Hopkinson's Will.—Probate is stated to have been granted of the will of the late Dr. John Hopkinson. The value of the estate has been sworn at £74,672.

Central London Railway.—A party of members of the Society of Engineers paid a visit to the Post Office Station of the Central London Railway on Tuesday, 11th inst.

The Bradford Electric Tram Accident.—Major Cardew resumed his inquiry into this accident at Bradford yesterday. Technical and other evidence was given, and the inquiry closed.

West India Relief Fund.—A sub-committee of the West India Club was formed on October 3rd for the purpose of making arrangements for a concert in aid of the above fund. His Lordship, the Lord Mayor of London, has kindly given his patronage, and a concert will be held at the Queen's Hall, kindly lent for the occasion by Mr. Robert Newman on October 19th next, at 8 o'clock p.m. It is hardly necessary to state how urgently funds are needed, and it is hoped that the public will give their support.

We understand that the Halifax and Bermudas Cable Company caused subscriptions to be collected at Turk's Island and Bermuda with the result that the former contributed £100 and the latter colony £127, and 23 packages of clothing.

Lecture.—Mr. A. Colson, the city electrical engineer at Leicester, delivered the presidential address before the Leicester Literary and Scientific Society on Monday night. He devoted it exclusively to electricity.

Appointments Vacant.—The East Ham Urban District Council is wanting an electrical engineer at £300 per annum, for the preparation of a combined electric lighting and traction scheme, and for the erection and management thereof. For particulars apply to Mr. Savage, the engineer and surveyor to the Council. The latest date for lodging applications is 24th inst.

The Halifax Corporation want an assistant electrical engineer at £132 per annum. See our "Official Notices" this week.

The Barking Town District Council are wanting an electrical engineer to superintend the laying of mains, erection of plant, &c., at £150 per annum. See our "Official Notices" for particulars.

NEW COMPANIES REGISTERED.

Veale & Co., Limited (59,019).—This company was registered on October 3rd, with a capital of £30,000 in £1 shares, to adopt an agreement with a company of the same name and J. W. Coon, its liquidator, and to carry on the business of electricians, electrical and general engineers, suppliers of electricity, electrical apparatus makers, machinists, tool makers, &c. The subscribers are:—Wm. T. Lovering, St. Austell, clay merchant, 25 shares; Herbert W. Wilson, St. Austell, engineer, 1 share; J. W. Burleigh, St. Austell, draughtsman, 1 share; N. Oliver, St. Austell, clerk, 1 share; Wm. J. Parnall, St. Austell, clerk, 1 share; F. H. Headley, St. Austell, electrical engineer, 174 shares; J. E. Veale, J.P., North Hill, St. Austell, 1,469 shares. The number of directors is not to be less than two nor more than seven; the first are John E. Veale, Silvanus Trevail, Edwin C. Spooner, and Frederick H. Headley; qualification, £250; remuneration, £100 per annum divisible.

British Polyphon Syndicate, Limited (59,028).—This company was registered on October 3rd, with a capital of £10,000 in £1 shares, to acquire and carry on the businesses of dealers in polyphons and electric kaloscopes carried on by Arnold Witt & Co. at 280, High Holborn, London, and by T. S. Goddard at 35, Trelawn Road, Leyton, E. The subscribers (with one share each) are:—M. W. Stikeman, Belgrade Road, Hampton, gentleman; A. W. Stocks, Bank House, Weybridge, clerk; J. A. Howland, 92, Colehill Lane, Fulham, S.W., traveller; E. A. Sutton, The Ferns, Burghley Road, Hornsey, manager; N. L. Stocken, 41, Woodstock Road, Bedford Park, W., gentleman; W. H. B. Scott, 33, Holborn Viaduct, E.C., land agent; A. W. Wilson, 35, Castlenau, Barnes, gentleman. The number of directors is not to be less than three nor more than seven; the first are A. W. Witt, T. S. Goddard, N. L. Stocken, and R. C. Kelly; remuneration as fixed by the company.

Forward Engineering Company, Limited (59,038).—This company was registered on October 4th, with a capital of £50,000 in £5 shares, to acquire and take over as a going concern the business carried on by Thomas Barker, at Birmingham and elsewhere, under the style or firm of "T. B. Barker & Co.," to enter into an agreement with "The Birmingham Trust, Limited," and to carry on the business of gas, steam, oil, and electrical engine and motor manufacturers and dealers, mechanical, hydraulic, electrical and general engineers, iron, steel, brass and copper founders, rollers and workers, carriage and waggon builders, &c. The subscribers (with one share each) are:—Arthur Chamberlain, J.P., Moor Green Hall, Birmingham; Laurence W. Hodson, Compton Hall, near Wolverhampton, brewer; Tom B. Barker, Westfield-Dorridge, Knowle, Warwick, engineer; Maurice Pollack, J.P., Stewart Lane, Yardley, near Birmingham; J. Dannell Garrett, The Firs, King's Norton, Worcester, engineer; R. A. Pinsent, 6, Bennett's Hill, Birmingham, solicitor; and A. W. Freeman, 6, Bennett's Hill, Birmingham, solicitor. The number of directors is not to be less than two nor more than seven; the first are Laurence W. Hodson, Thomas B. Barker and John D. Garrett; qualification, 100 shares; remuneration of Laurence W. Hodson, £150 per annum; of Thomas B. Barker and John D. Garrett, £100 each per annum.

"Positive" Meter Company, Limited (59,076).—This company was registered on October 7th, with a capital of £110,000 in £1 shares, to acquire any patents, inventions, and rights relating to meters for gas, oil, water, electricity, or other fluids or forms of power, to carry on the business of meter manufacturers, electricians, gas, hydraulic, and mechanical engineers, metallurgists, merchants, contractors, suppliers of gas and electricity, &c., and to enter into agreements (1) with the Baker Syndicate, Limited; (2) with John F. Wright, George E. Wright, and Andrew G. Sutherland; (3) with John Wright & Co., Limited; and (4) with John Greenall. The subscribers (with one share each) are:—H. A. Grimsdick, 18, Trefoil Road, Wandsworth Common, S.W., clerk: E. Dyke, Shepperton Green, Shepperton, Middlesex, clerk; F. M. Hulbert, 62, Gondar Gardens, West Hampstead, clerk; A. Burrell, 50, Carter Street, Lorrimore Square, S.E., accountant; H. W. Quittenden, 10, Sudbourne Road, Brixton, S.W., gentleman; R. Warner, 10, Walbrook, E.C., F.C.A.; and H. R. Weston, 10, Walbrook, E.C., accountant. The number of directors is not to be less than three nor more than five; the first are to be nominated by the subscribers; qualification, 200 shares; remuneration, £150 each per annum and an extra £50 for the chairman.

British Columbia Telephones, Limited (59,084).—This company was registered on October 8th, with a capital of £100,000 in £10 shares (3,000 £6 per cent. cumulative preference), to adopt an agreement with the New Westminster and Burrard Inlet Telephone Company, Limited, to acquire telephone lines in British Columbia or elsewhere, and shares in telephone companies, and to carry on business as telephone and telegraph proprietors. The subscribers (with one share each) are:—Joseph Wheatley, Woodlands, Mirfield, woollen manufacturer; Joseph Crowther, Woodley, Huddersfield, woollen manufacturer; Frederick W. Bentley, Dalton Grove, Huddersfield, stockbroker; Robert I. Critchley, Hyrst House, Dewsbury, colliery proprietor; Geo. Sheard, the Woodlands, Batley, woollen manufacturer: Frederick Priestman, Pierremont, Bradford, manufacturer; John H. Wade, Bradford, solicitor. The number of directors is not to be less than three nor more than seven; the first are Edwin Gray, Frederick Priestman, Joseph Wheatley, and William Farrell; qualification, £500; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Keswick Electric Light Company, Limited (28,820).—This company's annual return was filed on August 26th. The capital is £5,000 in £1 shares. 3,420 shares have been taken up, and the full amount has been called and paid.

Chloride Electrical Power Storage Syndicate, Limited (35,389).—This company's annual return was filed on September 18th. The capital is £262,500, divided into 80,000 "A" preference, 30,000 "B" preference, 140,000 "C" preference, and 12,500 founders' shares, all of £1. 80,000 "A," 30,000 "B," 100,000 "C," and 12,500 founders' shares have been taken up. 15,000 "A" and all the others are considered as fully paid, and £1 per share has been called and received on 65,000 "A" shares.

Mexico Electric Tramways, Limited (56,932).—This company's statutory return was filed on August 22nd, when seven shares were taken up out of a capital of £500,000 in £1 shares, no calls being made.

CITY NOTES.

Wireless Telegraph and Signal Company, Limited.

The second ordinary general meeting was held last Friday at the Cannon Street Hotel. Mr. Henry J. Davis, managing director, presided.

The Chairman, in moving the adoption of the report, reminded them that when the company was started a year ago Mr. Marconi was in Italy making experiments at the request of the Italian Government for their navy. The experiments were so satisfactory, that he was requested by the Italian naval authorities to proceed to Spezia, and to make experiments in connection with wireless telegraphy on two battleships which were placed at his disposal, the land station being situated at the arsenal. These experiments were thoroughly satisfactory, and the Italian authorities decided on adopting the invention for their navy. It had been in use ever since to their utmost satisfaction. On the return of Mr. Marconi, demonstrations were carried out at Salisbury, the first long-distance experiment made at the time being between Bath and Salisbury. The receiver in this case was given to a Post Office official, who went to Bath with it, where he, by himself, rigged up a station, at which he received signals 34 miles distant, where they were sent from at Salisbury.

They subsequently placed a permanent station at Alum Bay, Isle of Wight, which was first used in connection with a small steamer that was chartered, and which cruised about in the neighbourhood. The vessel cruised a distance of 18 miles, and it was in constant telegraphic communication at all times. Of course, various experiments were made prior to this, before the company was formed. One experiment was at Salisbury, when short-distance work was done for the Post Office and other Government officials; and Mr. Preece, of the Post Office, afterwards lectured on the matter, and stated how highly pleased they were, and of what great use the invention would be to the public, more especially in connection with lighthouses and lightships. Various exhibitions were given after that—one at the House of Commons and another at St. Thomas's Hospital. They also had many exhibitions at the offices of the company in Mark Lane. Lord Kelvin visited the station at Alum Bay, another station being at Bournemouth. His Lordship was very pleased with what he saw, and sent various telegrams to friends of his, among others to Mr. Preece. The Italian Ambassador, with various members of his staff, went to the Isle of Wight the day following Lord Kelvin's visit, and made various experiments with complete success, among the messages sent by him being a long telegram in Italian, which was sent to the first aide-de-camp to the King of Italy. Mr. Marconi's assistants had no knowledge of Italian, and the message might therefore be regarded as a code communication, and it was received exactly as it was sent. They previously had a display for the *Times* and the ELECTRICAL REVIEW, whose representatives put the invention to various tests, among others despatching a long code message, which had to be repeated. The correspondents, in their report, stated that this message was received exactly as it was sent. Following this, in July, they were requested by a Dublin paper to report the Kingstown Regatta. A land station was erected in the grounds of the harbour-master at Kingstown, and a steamer was chartered. The regatta was fully reported, messages being received from the ship at all distances. As they were received they were sent on to Dublin, and were published in the succeeding editions of the evening papers. After this Mr. Marconi was required to erect a station at Osborne House to connect with the Prince of Wales's yacht. Messages were thus reported to Her Majesty daily by means of wireless telegraphy. Various messages were also sent by other members of the Royal family, who were much pleased with the experiments. At the same time they had an installation at work for Lloyd's between Ballycastle and Rathlin Island. During the time it was up they reported several ships which were passing, and Lloyd's were thoroughly pleased with the success attending the experiments. They hoped to conclude a contract with Lloyd's for which they were now in treaty. Since the issue of the directors' report they had had, in consequence of the expiration of the lease, to remove their station at Bournemouth, which was 14½ miles from Alum Bay. Instead of looking for other quarters in Bournemouth, they went four miles further west. The distance was thus 18 miles from Alum Bay, but this increase of distance had had no detrimental effect whatever on the working of the messages. They had sent one or two of their assistants abroad to make demonstrations in connection with their patent rights. A telegram was handed to him just as he came into the meeting room, asking if the Government or the Post Office were not, as had been reported, trying to stop them; but so far from this being the case, they had requested them to put up the system between Guernsey and Sark, and had offered them a post office at each end. This was a matter which they would go on with at once. They had just received permission from the French Government to put up a station at Calais, and they now proposed to conduct experiments between Calais and Dover. They had applied for a number of patents in foreign countries. They had applied for 29, and had already received 22, and there seemed to be no opposition to them. They must not look for a decrease in the expenses; they wanted them to increase to develop the invention and to get it adopted. He hoped that in a short time they would come to an arrangement with Lloyd's, and in that case that body would use their influence to have the system adopted in the mercantile marine. When this was done he hoped they would be in a position to earn dividends.

Mr. J. FITZGERALD BANNATYNE seconded the motion, which was carried unanimously.

An extraordinary general meeting was held subsequently, at which resolutions were passed increasing the capital of the company to £200,000 by the creation of 100,000 shares of £1 each, 25,000 of them to be issued at once, at par, to shareholders now on the register, and making a certain alteration in clause 55 of the articles of association as to the voting power of the members, no member to be entitled to vote in respect of any shares held by him in excess of two-fifths of the issued capital for the time being of the company.

The Telegraph Manufacturing Company, Limited.

THE following report has been furnished to us by the company:—

The statutory meeting of the shareholders of this company, whose works are at Helsby, near Warrington, was held at the Law Association Rooms, Liverpool, on Friday last. Mr. James Taylor, chairman of the board, presided, and Messrs. Geo. C. Taylor and F. Whiteley, directors, were also present. There was a fair attendance of shareholders. Mr. Brotherton, secretary, having read the notice convening the meeting,

The CHAIRMAN said this was a statutory meeting, and the directors had no accounts nor any resolutions to propose, but the shareholders would naturally be interested in knowing how the company was going on. In the first place he must refer to the sad loss they had sustained in the death through a terrible accident of Dr. John Hopkinson, a man in the very first rank of electrical industry. They could not calculate what they had lost through his death. The matter of appointing another director had been under discussion for some time, but could not be decided because one of the directors had only recently returned from Russia. The shareholders would be duly apprised when the appointment was made. As regards the company's work generally, the company was floated most successfully, and the shares, both preference and ordinary, were very largely over applied for, and the main difficulty of the directors was in the allotment. He had no doubt they had not pleased everybody, although they tried to do so. According to the last quotation of their shares on the market the premium on the ordinary shares of £5, on which only £3 per share had been paid, was 37s. 6d., and on the preference shares 15s., which, seeing that no accounts had yet been issued, was a very good thing for the company. He only hoped that when they met in June next they would be able to live up to that quotation. The company's works and premises were in first-rate order, and for the past six months they had been working practically night and day. In fact, their main difficulty was to make their goods fast enough. They already had under consideration the question of extensions. Of course, the electrical industry was growing most rapidly, electricity being employed more and more for power for tramway and other systems, employing cables such as they made. All the firms which were making them were in the same position as themselves—overwhelmed with work, and if they were going to share in the prosperity of this industry for the next 10 years, they must lay themselves out to find the material which people must have for all their power for traction work, and this company intended doing that. They stated in the prospectus that the sales for three months prior to the issue of the prospectus were some 50 per cent. in excess of what they had been in the corresponding three months of the previous year. They hoped to meet again in June, and to give a satisfactory account of the year's work. That was all the business for this meeting.

On the motion of Mr. KAY, seconded by Mr. J. S. H. BANNER, cordial thanks were voted to the chairman for his statement, and the proceedings then closed.

The Indo-European Telegraph Company.—The directors have declared an interim dividend for the half-year ended June 30th at the rate of 5 per cent. per annum, free of income-tax, payable on and after November 1st next. The transfer books will be closed from October 17th to 31st, both inclusive.

Isle of Man Tramways and Electric Power Company.—Last week the board issued warrants for an interim dividend on two classes of shares. They have declared the same division as last year, viz., 6 per cent. on the preference and 7½ per cent. on the ordinary shares.

Globe Telegraph and Trust Company.—The board announce a quarterly interim dividend of 3s. per share on the preference shares, and of 1s. 9d. per share on the ordinary shares.

Stock Exchange Notices.—Application has been made to the Stock Exchange Committee to appoint a special settling day in and to grant a quotation to:—Telegraph Manufacturing Company, Limited—13,400 ordinary shares of £5 each; and 13,400 5 per cent. cumulative preference shares of £5 each. The Committee has also been asked to allow the following to be quoted in the Official List:—Willans & Robinson, Limited—Further issue of 7,500 ordinary shares of £5 each, fully paid, Nos. 22,501 to 30,000; and 7,500 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 52,501 to 60,000.

The St. James's and Pall Mall Electric Light Company, Limited.—The amount of electricity sold by this company for the quarter ending September 29th, 1898, is returned at 583,034 units, estimated to produce £11,111, as against 500,158 units for the same quarter of last year, which produced a net revenue of £10,940.

TRAFFIC RECEIPTS.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending October 7th, 1898, were £2,974 17s. 4d.; corresponding period, 1897, £2,749 13s. 9d.; increase, £225 3s. 7d.

The City and South London Railway Company.—The receipts for the week ending October 9th, 1898, were £982; week ending October 10th, 1897, £970; increase, £12; total receipts for half-year, 1898, £14,251; corresponding period, 1897, £13,591; increase, £660.

The Dover Corporation Electric Tramways.—The receipts for the week ending October 8th, 1898, were £201 13s. 4d.; week ending October 9th, 1897, £124 1s. 9d.; increase, £77 11s. 7d.; total receipts to October 8th, 1898, £6,618 8s. 8d.

The Dublin United Tramways Company.—The receipts for the week ending October 7th, 1898, were as follows:—D. U. T. Co., horse cars, £2,535 13s. 8d.; ditto, electric cars, £444 8s. 10d.; D. S. D. Co., electric cars, £929 6s. 2d.; total, £3,909 8s. 8d; corresponding week last year—D. U. T. Co., horse cars, £2 866 5s. 6d.; D. S. D. Co., electric cars, £533 8s. 9d.; total, £3,419 14s. 3d.; increase, £489 9s. 5d.; aggregate to date, £61,799 18s. 7d.; aggregate to date last year, £56,822 17s. 10d.; increase to date, £4,977 0s. 9d. Worked:—The mileage open is 13 miles electrically, 31 miles by horses, as against 8 miles electrically, and 34 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending October 9th, 1898, amounted to £1,899; corresponding week last year, £1,331; increase, £78.

The Western and Brazilian Telegraph Company, Limited.—The receipts for the week ending October 7th, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £5,254.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, Oct. 5th.	Closing Quotation, Oct. 12th.	Business done during week ended Oct. 12th. 1898. Highest.	Lowest.
137,400£	African Direct Telegraph, 4 % Debs.	100	4 %	...	...	100 —104	100 —104	102½	...
25,000	Amazon Telegraph, shares	10	...	...	...	6 — 7	6 — 7	...	...
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	92 — 95	92 — 95	...	...
923,960£	Anglo-American Telegraph	Stock	£2 9s	£2 13s	3 %	63 — 66	64 — 67	65½	65½
3,038,020£	Do. do. 6 % Pref.	Stock	£4 18s	£5 6s	6 %	115½—116½	115½—116½	116⅜	115½
3,038,020£	Do. do. Deferred...	Stock	...	...	...	15⅜— 16½	15⅜— 16	15⅝	...
130,000	Brazilian Submarine Telegraph	10	7 %	7 %	7 %	15⅜— 16½	15⅜— 16½	15⅞	...
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	5 %	...	...	111 —115	111 —115	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	4 %	2¾— 3½	2¾— 3½	...	...
10,000,000$	Commercial Cable	$100	7 %	8 %	8 %	180 —190	180 —190	...	...
918,297£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106 xd	104 —106	105½	104½
224,850	Consolidated Telephone Construction and Manufacturing	10/-	1½ %	2 %	...	1/16— 1/8	1/16— 1/8	...	...
16,000	Cuba Telegraph	10	8 %	8 %	7 %	8½— 9½	8½— 9½	9½	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	15 — 16	15 — 16	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	4 — 5 xd	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11 xd	10 — 11	...	...
30,000£	Do. do. 4½ % Debs., Nos. 1 to 6,000 ...	50	4½ %	4½ %	4½ %	103 —106%	103 —106%	...	...
60,710£	Direct United States Cable	20	2½ %	2½ %	...	11½— 12	11½— 12	11⅞	11⅞
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101 —104	101—104	...	...
400,000	Eastern Telegraph, Nos. 1 to 400,000	10	6½ %	6½ %	7 %	17¾— 18¼	17¾— 18¼	18⅛	17¾
1,295,000	Do. 3½ % Pref. Stock	100	...	...	...	105 —108	105 —108	106	105½
40,000	Do. Prov. Certs., 50 % paid	...	...	...	...	52 — 53	52 — 53	...	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	5 %	100 —103	100 —103	...	...
1,302,615£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	126 —130	126 —130	129	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	17½— 18	17½— 18	17⅞	17⅝
25,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	5 %	100 —104	100 —104	101	...
100,500£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	5 %	101 —104	101 —104	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	125 —129	125 —129	127	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	...	100 —104	100 —104	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	101 —104	101 —104	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	4 %	...	102 —105	102 —105	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	4 %	...	104 —107%	104 —107%	...	...
180,227	Globe Telegraph and Trust	10	4⅛ %	4⅛ %	4⅛ %	12 — 12⅛	12 — 12⅛	12⅛	12⅛
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	16¾— 17¼	16¾— 17¼	17⅛	16¾
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	10 %	28½— 29½	28½— 29½	...	...
160,000£	Do. do. do. do. 5 % Debs. ...	100	5 %	5 %	5 %	101 —104	101 —104	...	...
97,000	Halifax & Bermuda Cable, 4½ % 1st. Mt. Dbs., w'n. 1-1,200, rd.	100	...	...	...	101 —104	101 —104	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	51 —54	51 — 54	54	...
100,060£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	6 %	109 —112	109 —112	...	...
28,000	Montevideo Telephone, 6 % Pref., Nos. 1 to 28,000 ...	5	4 %	4 %	4 %	2¼— 2⅜	2¼— 2⅜	...	...
484,597	National Telephone, 1 to 484,597	5	5⅛ %	5⅛ %	6 %	5⅜— 5⅝	5⅜— 5⅝	5 9/16	5 7/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	13½	12½
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	12 11/16	12½
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	5 7/16	5⅜
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100 —105	100—105	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅝— ¾	⅝— ¾	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	4 %	105 —108	105 —108	...	...
11,839	Reuter's	8	5 %	5 %	5 %	8 — 9	8 — 9	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	136 —141	136 —141	...	...
58,000	United River Plate Telephone	5	4 %	5 %	6 %	4½— 4⅝	4½— 4⅝	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	...	...	103 —106	103 —106	...	...
15,609	West African Telegraph, 7,501 to 23,109	10	4 %	*nil*	*nil*	3½— 4½	3½— 4½	...	...
218,400£	Do. do. 5 % Debs.	100	5 %	5 %	5 %	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ¼	⅛— ¼	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	104 —107	104 —107	104½	...
64,269	Western and Brazilian Telegraph	15	3 %	2 %	3½ %	12¼— 12⅜	12¼— 12⅜	12 5/16	...
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	5 %	8 — 8½	8 — 8½	...	...
33,129	Do. do. do. Def. Ord.	7½	1 %	*nil*	½ %	4 — 4½	4 — 4½	...	...
389,521	Do. do. do. 4 % Deb. Stock Red. ...	Stock	...	...	...	107 —110	107 —110	...	...
88,321	West India and Panama Telegraph	10	⅜ %	1 %	¾ %	1 — 1¼	1 — 1¼	1⅛	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	6 %	9¼— 9¾	9¼— 9¾	9⅝	9¼
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	6 %	7 — 9	7 — 9	8¼	7¾
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	106 —109	106 —109	...	...
1,163,000$	Western Union of U.S. Telegraph, 7 % 1st Mort. Bonds	$1000	7 %	7 %	7 %	105 —110	105 —110	...	...
160,100£	Do. do. do. 6 % Ster. Bonds ...	100	6 %	6 %	6 %	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	5 %	6 %	7 %	12 — 13	11½— 12½	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
26,000	*Chelsea Electricity Supply, Ord., Nos. 1 to 10,277... ...	5	5 %	5 %	6 %	9 — 10	9 — 10	...	...
60,000	Do. do. do. 4½ % Deb. Stock Red....	Stock	4½ %	4½ %	4½ %	113 —115	113 —115	...	...
50,000	City of London Electric Lighting, Ord. 40,001—90,000 ...	10	5 %	7 %	10 %	24½— 25½	24 — 25	25¼	25
10,000	Do. Ord. Nos. 90,001 to 100,000	10	...	...	...	24 — 25	23½— 24½	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16½— 17½	16½— 17½	16⅝	16⅛
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	125 —130	127 — 132	131	130½
30,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000	10	*nil*	*nil*	*nil*	13 — 14	13 — 14	13⅓	13
10,000	Do. do. do. Nos. 30,001 to 40,000 £8 paid.	10	...	...	...	10½— 11½	10½— 11½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14½— 15½	14½— 15½	15½	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	...	5 %	5¼— 5⅝	5¼— 5⅝	5⅝	...
10,000	House-to-House Electric Light Supply, Ord., 101 to 10,100	5	...	...	4 %	9 — 10	9 — 10	...	...
10,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	7 %	9½— 10½	9½— 10½	9⅝	...
62,400	*Metropolitan Electric Supply, 101 to 62,500	10	4 %	5 %	6 %	17 — 18	16⅝— 17½	17½	16⅞
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	4½ %	116 —120	117 —121	...	...
6,452	Notting Hill Electric Lighting	10	2 %	4 %	6 %	15½— 16½	15½— 16½	17⅛	17
31,980	*St. James's and Pall Mall Electric Light, Ord.	5	7½ %	10½ %	14½ %	17 — 18	16⅝— 17½	17⅜	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
50,000	Do. do. 4 % Deb. Stock Red. ...	Stock	...	...	4 %	105 —108	104 —107	...	...
43,341	South London Electricity Supply, Ord., £2 paid	5	...	...	...	2¾— 3⅛	2¾— 3⅛	3	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	7 %	9 %	12 %	16 — 17	15½— 16½	16⅜	15⅞

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation Oct. 5th.	Closing Quotation Oct. 12th.	Business done during week ended Oct. 12th, 1898. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	...	...	...	3 — 3¼	2⅞— 3⅛	2⅞	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	94 —100 xd	94 —100	...	...
30,000	British Electric Traction	10	...	...	...	16⅜— 17¼	16⅜— 17¼	17	16 13/16
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	13 — 14	13 — 14	13 9/16	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	2½%	*nil*	*nil*	1¾— 2	1¾— 2	1 15/16	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	*nil*	4 %	2⅛— 2⅜	2⅛— 2⅜	2 5/16	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	107 —111	109 —113	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	102 —105	102 —105	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	...	...	...	10 — 11	10 — 11	...	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	110—113	110 —113	...	...
19,894	Central London Railway, Ord. Shares	10	...	...	...	10 — 10½	10 — 10½	10½	10⅜
129,179	Do. do. do. £6 paid	10	...	...	...	6 — 6⅛	6 — 6⅛	6⅜	6 5/16
59,254	Do. do. Pref. half-shares £1 paid ...	...	...	...	...	1¼— 1⅜	1¼— 1⅜	1⅜	1⅜
67,680	Do. do. Def. do. £5 paid ...	...	...	...	...	4½— 5	4½— 5	...	...
630,000*l*	City and South London Railway	Stock	1 8/16 %	1 9/16 %	1⅞%	70 — 72	70 — 72	71½	70½
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £3 pd.	10	...	...	...	2⅜— 3¼	2⅜— 3¼	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	1½— 2	1½— 2	...	...
82,850	Do. 5% 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red.	...	...	...	...	90 — 95	90 — 95	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5 %	5⅛%	6 %	2¼— 2⅜	2¼— 2⅜	2⅜	2¼
17,139	Do. do. do. "A" Shares, 01—017,139	5	5 %	5⅛%	6 %	4 — 5	4 — 5	4½	...
194,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	101 —103	101 —103	103	...
110,000	Electric Construction, 1 to 110,000	2	5 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2 5/16	2¼
16,343	Do. do. 7 % Cum. Pref., 1 to 16,343 ...	2	7 %	7 %	7 %	2⅜— 3½	2⅜— 3½	...	...
111,100	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	105 —107	105 —107	106½	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅜— ⅝	⅜— ⅝	...	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	¼— ½	¼— ½	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	10½%	7 %	7 %	10 — 12	10 — 12	...	...
12,500	Henley's (W. T.) Telegraph Works, Ord.	10	8 %	10 %	12 %	20⅜— 21⅓	20⅜— 21⅓	21 5/16	21¼
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18 — 19	18 — 19	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	4½ %	110 —115	110 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	22½— 23⅛	22½— 23⅛	23⅜	22¾
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	101 —105	101 —105	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞%	2⅞%	3⅛%	10 7/16 — 10 9/16	10⅜ — 10½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15⅝— 16	15⅝— 16	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	39 — 43	39 — 43	41	...
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	100 —103	100 —103	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	...	117 —122	115 —120	120	116½

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10¼.

British Aluminium, Ordinary, 10⅛—11⅛; 7 % Pref., 12—13.

House-to-House, 4½% Debentures of £100, 106—109.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 14—15; 1st Preference Cumulative 6%, £5 (fully paid), 7⅜—8¼. Debentures, 107—109. Dividend, 1897, on Ordinary Shares 10%.

London Electric Supply Corporation, £5 Ordinary, 3⅜—4.

National Electric Free Wiring, 10s. paid, ⅜—½.

*T. Parker, £10 (fully paid), 13—13½.

Yorkshire House-to-House Electricity, £5 Ordinary Shares fully paid, 7⅞—8¼. Dividend for 1896—6%.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (September 22nd. 1898).

MARKET QUOTATIONS, Wednesday, October 12th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	32/-	32/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per ton	37/-	37/-	..
a Ammonia, Muriate (grey) .. per ton	£19	£19	..
a „ „ (white) .. per ton	£26	£26	..
a Bleaching powder .. .. per ton	£6 15	£6 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£14 10s.	£14 10s.	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£17	£17	..
a Lead, Nitrate .. .. .. per ton	£23 10s.	£23 10s.	..
a „ White Sugar .. .. per ton	£80 10s.	£80 10s.	..
a „ Peroxide .. .. .. per ton	£27 10s.	£27 10s.	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3¾d.	3¾d.	..
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. .. per cwt.	64/-	64/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6 10	£6 10	..
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£8 15	£8 15	..
a „ Crystals .. .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	3d.	3d.	..

METALS, &c.	This week.	Last week.	Increase or Decrease.
b Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
c Brass (rolled metal 2' to 12') basis per lb.	6¼d.	6¼d.	..
c „ Tube (brazed) .. .. per lb.	8¼d.	8¼d.	..
c „ Wire, basis .. .. per lb.	6¼d.	6¼d.	..
f Ebonite Rod .. .. .. per lb.	5/-	5/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£63	£62	£1 inc.
g „ Wire (basis price) .. per lb.	7¾d.	7¾d.	..
g „ Sheet .. .. .. per ton	£63	£62	£1 inc.
g „ Rod .. .. .. per ton	£63	£62	£1 inc.
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	5/6	5/6	..
h India-rubber, Para fine .. .. per lb.	3/9½	3/10½forw'rd	1d. dec.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	44/2½	43/8	6½d. inc.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	45/-	45/-	..
i „ Wire galvanised No. 8 .. per ton	£8 15	£8 15	..
g Lead, English Ingot .. .. per ton	£13 5	£13	5s. inc.
g „ „ Sheet .. .. per ton	£14 5	£14	5s. inc.
l Mica .. .. .. per lb.	5/6	5/6	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. .. per bottle	£7 4	£7 4	..
o Platinum .. .. .. per oz.	£2 16	£2 16	..
i Steel, Magnet, according to description .. .. .. per ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£80 10	£78	£2 10s. inc
g „ foil .. .. per lb.	1/3	1/3	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	6¾d.	6¾d.	..
j „ Flax, 6 or 8 lea... .. per lb.	3¾d.	3¾d.	..
j „ Hemp, 3 ply 10 lbs. .. per lb.	3¾d.	3¾d.	..
j „ „ Russian, 10 lbs. per lb.	4¼d.	4¼d.	..
j „ Jute, 180 lbs. rove .. per ton	£11 10	£11 10	..
j „ Manila, 24 thread .. per ton	£31	£31	..
k Zinc, Sheet (Vielle Montagne brand) .. .. per ton	£27	£26	£1 inc.

a Quotations supplied by Messrs. G. Boor & Co.
b „ „ „ The British Aluminium Co., Ltd
c „ „ „ Messrs. Thos. Bolton & Sons.
d „ „ „
„ „ „
„ „ „ The India-Rubber, G.-P., and Teleg. Works Co Ltd
g „ „ Messrs. James & Shakspeare.
„ „ Jackson & Till.

i Quotations supplied by Messrs. Bolling & Lowe.
j „ „ „ „ Henry C. Yeo & Co.
k „ „ „ „ Morris Ashby, Limited.
l „ „ „ „ Sanders, Wake & Co.
m „ „ „ „ W. T. Glover & Co., Ltd.
n „ „ „ „ P. Ormiston & Sons.
o „ „ „ „ Johnson Matthey & Co.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, BRISTOL, 1898.

ELECTRIC TRACTION BY SURFACE CONTACTS.

By S. P. Thompson and Miles Walker.

Read in Section G, September 12th.

(*Concluded from page* 542.)

A large number of methods for series working are due to Mr. F. C. Esmond, of New York. One of his simplest is shown in fig. 8. Here no inter-connection is required between

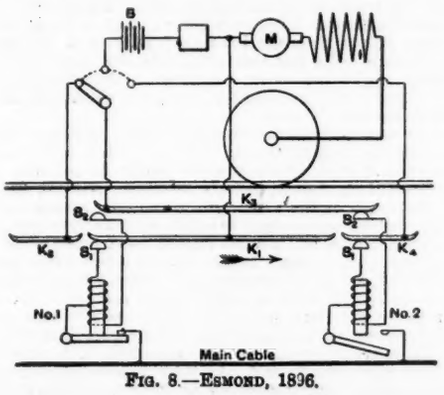


Fig. 8.—Esmond, 1896.

the switch boxes, the current being carried forward by means of several skates. In the diagram, fig. 8, the current is flowing to the motor from the main by means of K_1 and S_1 of switch No. 1. A moment later K_2 will come in contact with S_1. The current will then pass to K_2 and thence by S_2 of switch No. 2, through the winding of that switch to S_1 and thence to the car. Thus switch No. 2 is closed, and the process made continuous. The method of closing the switches by means of an independent battery may be illustrated in fig. 9. Two rows of studs, S_1 and S_2, are required, and two skates,

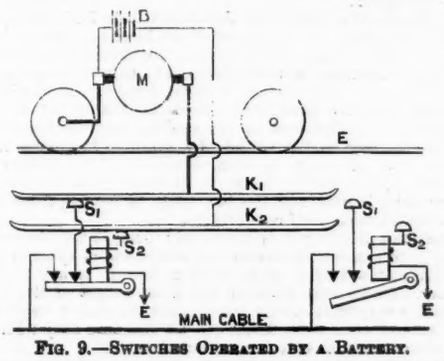


Fig. 9.—Switches Operated by a Battery.

K_1 and K_2. The diagram explains itself. The practical details of a system of this kind have been brought to great perfection by the Westinghouse Company of America. A branch line of the Washington tramways has been operated by this company on what has been called the Wheless system since 1894. Mr. Holroyd Smith has described several modifications of the method. There are two drawbacks apart from the necessity of two rows of studs.

In the first place the accumulator cells are continually in use, and the running of the car is entirely dependent upon them. In the next place the low pressure of a few accumulator cells is not so satisfactory for overcoming the resistance of mud or ice upon the studs as the full 500 volts of the supply main. It would take too long to describe the commutator system of Claret Vuillenmier as laid in Paris, and the line equipped at Monte Carlo by the General Electric Company of America. It is sufficient to note that these systems have proved the practicability of picking up current from studs laid in the road.

When we review all these different methods, we see that the direct magnetic pick-up systems, with a magnet on the car while operating with somewhat feeble forces, have a great element of safety, in the fact that the forces cannot operate when the car is not there. The system in which the electro-magnet is in the switch itself, on the other hand, can be made to operate with very great forces, but there is a danger (only to be avoided by complicating the system) of those very forces keeping the switch closed when the car is absent.

Now, it is possible to combine the advantages of both methods and to avoid their defects. All that is necessary is to make the magnet of the switch operate by attraction on a piece of iron on the car. When the car is absent the switch cannot be held closed because the magnet has nothing to attract, at the same time it is found possible in practice to obtain very great working forces. Upon this principle the authors have constructed an experimental line near Willesden Junction; the main object being to try the practicability of the system upon curves, crossings, and sudden changes of slope. Out of various designs depending upon the closing of a magnetic circuit by the iron of the car, the arrangement which has so far proved most successful in experiment consists of an iron plunger sliding in a vertical tube. If we take an iron plunger with expanded ends, like that numbered 2 in fig. 10, and

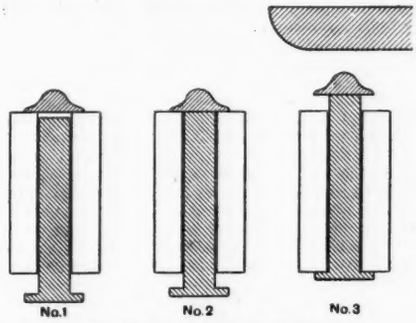


Fig. 10.—Experiments on Plungers.

surround it by a solenoid of wire, carrying a current, it is possible to choose the size of the heads so that the tendency of the plunger to assume a central position is balanced by the attraction of the solenoid on the iron head. Gravity being the only force upon the plunger it will, of course, take up the position shown. If now, a piece of iron is placed over it, as shown in No. 3, the plunger may be raised by the attraction between the two. In case a very heavy plunger is used it is possible to support part of its weight by merely increasing the size of the lower head by a small amount. Thus we have a simple piece of mechanism whose movement is entirely dependent upon the presence of a mass of iron in its neighbourhood, and which cannot be moved by the solenoid itself, even though the magnetising current carries the iron up to the saturation limit. This has been converted into the operating part of the switch. Now, though the force of attraction is sufficient to lift a fairly heavy plunger and operate a switch, it is desirable to have something more than this. We want a switch which will, notwithstanding its massive moving parts, close in an exceedingly short space of time. We want a very great acceleration upon the moving parts during the first part of their motion. This is easily obtained by merely separating the upper head from the plunger by a short air-gap, and arranging

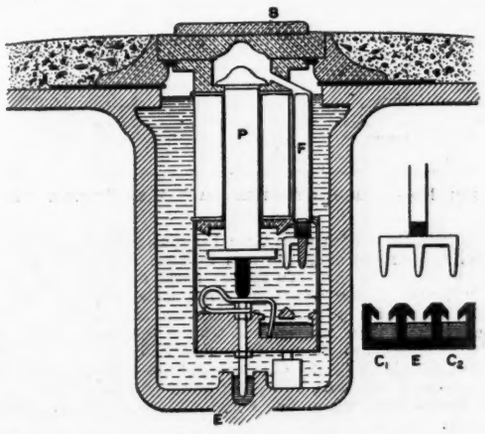


Fig. 11.—Thompson-Walker Method of Earthing.

matters so that the mass of iron comes over the switch before current is put through the magnetising coil. As soon as current passes, the attraction upon the head is so great that the plunger gets up a high velocity before the two come together, with the result that the switch operates as though it had been hit with a hammer. A very simple device, shown in a subsequent diagram, can be employed to prevent the switch from being injured by the concussion. The connection of this operating part to the contact points of the switch has been the subject of some very varied

experiments. It would be a pity to hamper a part so simple in itself with any gear at all. If the safety of street passengers could be made dependent upon nothing else than the falling of the plunger when the mass of iron is removed, it was thought that as great perfection would be attained as we can hope for from any moving mechanism. The attachment of any gear at once introduces the risk of friction, and the simplicity of the issue is destroyed. For that reason, as well as for cheapness and convenience, the method shown in fig. 11 was decided upon, though there are some simpler modifications of it still under experiment. The diagram, which is merely an incomplete sketch for a lantern slide, shows, in the first place, the cast-iron box which is laid in the street. This is surmounted by a gun-metal stud, s, faced with a phosphor-bronze wearing cap. The stud is insulated from the iron box by a sheet of micanite. A non-porous road material is placed around the stud to make up the level.

The box is filled with oil, which besides performing the function presently to be considered, maintains very high insulation throughout. The switch is attached to the stud, and comes away with it in one piece. Being only about 4 inches in diameter, no difficulty is found in making a perfectly watertight joint. The next point to consider is the method of making electrical contact. The requirements of switchpoints for disconnecting surface studs are the following:—

When closed, the contacts should be of low resistance, and capable of carrying 100 amperes easily. They should be incapable of fusing or sticking in any way, and should require only a small force to open them. They should retain their shape and efficiency unimpaired for a long time without requiring attention. It will be observed that the current through the stud ceases as soon as the skate parts company with the stud as the car moves forward. Hence in the operation of the car as the switch-plunger falls, it does not have to break the main current, that having already ceased. Yet although the switches are not required in the ordinary course to break a large current, it is desirable that they should be able, in case of accident, to do so without injury. After experimenting with different forms of contact, it was found that nothing fulfils these requirements so completely as a properly designed mercury contact. Mercury contacts are, therefore, used throughout these switches.

The yoke of copper which dips into the mercury is supported by a brass tube, which floats in the oil, and fits loosely into a fixed brass tube, which acts as a guide. When the plunger rises it takes the oil from under the float, which accordingly falls, and connection is made. When the plunger falls the float rises. As the plunger moves quickly the oil has not time to leak past the sides, notwithstanding the very loose fit of the parts. Thus the force upon the yoke piece is very great, and at the same time a long movement is obtained.

It will be seen from the diagram that three cups are employed; the two outer being connected to the main and the stud respectively. The main cup is enclosed in a metal sheath (not shown) permanently connected to earth, so that it is impossible for current to reach the stud except when the yoke is down. Now it will be seen from fig. 11 that when the plunger is down it earths the centre cup, so that if from any accident whatever the yoke piece

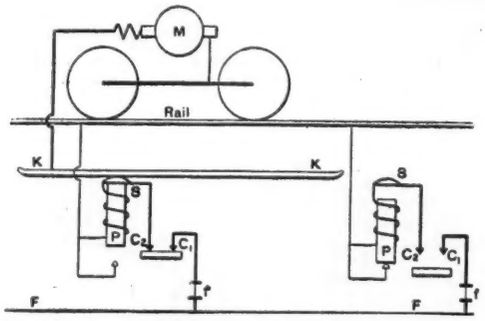


FIG. 12.—THOMPSON-WALKER DIAGRAM OF CONNECTIONS.

fails to open the switch after a car has gone past, the plunger puts the stud to earth and blows the fuse between it and the main. It is not necessary to have any special mode of connecting up the switch boxes. Either shunt or series coils may be used. In practice we prefer a shunt coil because the slightly increased expense is more than compensated for the smallness of the bulk. Our connections are shown diagrammatically in fig. 12, which sufficiently explains itself. Only one skate is employed, and this is in the centre of the car. This gives much greater facility in going round curves than where two skates and two rows of studs are necessary.

There are a number of practical details for which we have no room here, but which we hope shortly to bring before the Institution of Electrical Engineers. Throughout the work upon the experimental line we have been indebted to Mr. C. E. Holland for many valuable suggestions.

Reduction of Capital.—A petition for confirming a special resolution passed by the Monte Video Telephone Company for reducing the capital of the company from £220,000 to £160,000 will be heard before Mr. Justice Channell, sitting as Vacation Judge, at the Royal Courts of Justice, Strand, on Wednesday, October 19th.

ELECTRICAL ENGINEERS' SPECIFICATIONS.*

By J. ALEXANDER McLAREN.

(*Concluded from page* 539.)

HAVING now got through the preliminaries, we come to the specification proper, which is divided into sections, and are generally arranged as follows:—

1. Boilers and accessories.
2. Pipes.
3. Steam alternator.
4. Switchboard and meters.
5. Underground work.
6. Arc lamps.

As I have said before, we cannot pretend to discuss all these subjects, and will spend the remaining time on the first three.

Boilers.—The class of boiler used differ greatly in their construction. They are usually either Lancashire, Babcock & Wilcox, locomotive or marine. The first two being by far the most general, you can scarcely imagine two boilers so different in their design; yet it is generally a case of either one or the other, and often both are used in the same place.

There are many points to be dealt with when settling on the style of steam raisers. In large towns, where ground rent is heavy, and the price of land high, efficiency often has to be sacrificed to the keeping down of the annual charges involved. Another important point is the quality of the water used. As every central station is liable to be called upon suddenly to supply abnormally large demands, owing to sudden fogs, &c., it would appear that a boiler which raised steam quickly is a necessity. In the water-tube boiler this faculty is fully developed, and it is often used on account of this quality alone. The Lancashire boiler is often preferred, on account of its storage capacity, but to get steam quickly it is necessary to keep a boiler always in reserve under steam, so that the time required to get it in commission is not more than would be wanted with a water-tube boiler when the water is cold. In these two boilers we have the different extremes. Quick steaming, no storage, takes up little room in the one case, and slow steaming, large storage, uses much more space in the other case. A compromise of these qualities is found in a locomotive boiler. Boiling water in bulk as in the Lancashire boiler cannot be economical, especially under varying loads. The tubular boiler splits up the water, gives better heating surface, so must be more economical, but its small space available for water renders it more dangerous, and should the feed water be stopped no time is available to put matters right, and often the fires have to be drawn, whereas in the locomotive type we have a quick steam raiser, a fair storage capacity, and uses comparatively little space, while another advantage is that no brickwork or setting is wanted, so that, everything else being equal, it seems to fulfil nearly the conditions required. The question of maintenance and repairs requires some consideration.

In the Lancashire boiler the deterioration is fairly even, but it must not be forced. The great difference in expansion when a big fire is lit to raise steam quickly before the large mass of water is heated must do damage to the boiler, and it only requires this practice to be repeated often enough to cause disaster. In the Babcock and Wilcox's type the greatest trouble is the failure of the tubes owing to scaling. The caps on the sections opposite the tubes are dependent entirely on the thread of a screw to keep them in position, this piece of design is often objected to by engineers. The weak part of a locomotive boiler is undoubtedly the firebox, but when the water is good, and the box made of copper, it has a long life, and makes steam very comfortably.

The marine boiler, as yet, is not largely used; it may be described as a very good generator in a very bad shape, and as space is not of so much importance ashore as on board a ship, it is not likely that this boiler, with its large diameter and great extent of flat surface, necessitating very thick plates and a great amount of staying, will become general when other kinds can do the same duty with much less weight of material at a reduced first cost.

Pumps.—Little attention is given to such accessories as pumps, and the kind used is generally the one which costs least, but it would well repay the station engineer if he gave more consideration to this part of the plant. Most engineers, however, are in utter ignorance as to the performance of their pumps, and if they only knew the enormous amount of steam they swallow, they would not keep them on the premises a day longer than necessary; it would pay them over and over to sell them as scrap iron and buy something better. Slow running, direct acting pumps, without any fly-wheel, cannot possibly be economical; they require to carry steam so far along the stroke to keep them from stopping, that the steam must exhaust not much under the initial pressure; whereas a pump which runs as fast as possible with a large fly-wheel has a much better chance, because the steam can be cut off earlier in the stroke and allowed to expand while the fly-wheel gives out its energy. The more cylinders about a station the worse will be the efficiency, and it will always pay, when feasible, to work the pumps from the main engines. These slow-running pumps, with their little unjacketed, badly clothed cylinders, are nothing more or less than mechanical parasites on the installation. There appears to be an opening for a good economical pump. A certain engineer, who, by the way, takes nothing on trust, tested his pumps properly as well as everything else on his station, and he got some positively alarming results. He found that the circulating water pumps required no less than 300 lbs. of steam per pump horse-power per hour. The feed pumps were much worse—the results of their tests are really unfit for publication. Consequently, he is

* Read before the Yorkshire College Engineering Society.

having them all replaced, and they are quite new pumps. In the same station they can turn out electricity with engines using under 12 lbs. of steam per I.H.P., so that the phenomenal economy of the engines is to a great extent counterbalanced by excessively wasteful feed and circulating water pumps. When buying his new pumps, the guarantees which were given him were 46 lbs. of water per pump horse-power for compound circulating pumps, and 100 lbs. per pump horse-power for feed pumps. Injectors might often be used when cold water is taken for feed water, and the result cannot be beaten, as all the heat returns to the boiler.

Pipes, as a rule, have a section of their own, and they need it. If there is any part of the contract that requires care in estimating it comes under the heading of "Pipes," and many successful tenderers for this work have afterwards regretted that their's was the accepted one. The fact of the matter is, you cannot put too large a price on, and without the price is a very good one you are much better without it. It frequently happens that the firm which supplies the boilers or engines gets the pipes as well, but sometimes it goes to an outside firm altogether, which makes it worse for them. Now, from the day the first piece of machinery is delivered until the station is thoroughly completed the firm who supplies the pipes must have a man there practically all the time, not just a workman, but a capable man who can undertake the designing and arranging of the pipe system. Of course the pipe arrangement has all been laid down on paper. The makers of all the different parts of the plant have been written to, and after many delays particulars of the position and size of every flange have been received, so that he gets all his pipes ordered and all the valves, and only leaves making up pieces at the end of every pipe. So far, all this can be done in the drawing office, but when the machinery turns up it will be found that many of the flanges are totally different to the sketches sent, sometimes the style of feed pumps has been changed at the last minute. The pipes have to be supported from any convenient place, and plumbers' work, such as drain pipes, steam trap drains, &c., has to be done, so that this work is considerably above what is considered to be the average workman's ability.

Although not so closely packed as the pipes on board a steamship, there is a good deal of complication and cross-coupling in this work. The main steam pipes are either laid down in the well-known ring system, or are placed in duplicate to each engine, the latter being the more reliable plan, but also the most expensive. The ring system, however, with plenty of stop valves suitably placed, is safe enough for commercial purposes. Every boiler must have an independent blow-off pipe running to the sump. All engines and pumps must be connected to the condenser, and also must have valves to exhaust into the atmosphere when wanted, and where the condenser is an independent one, the pipes and valves increase in number. The pumps must pump through the economiser, or direct to the boilers at will. They must have connections to act as fire engines when necessary. The condensed water on its way to the hot well must pass through oil filters. Steam separators are plentifully distributed. All drains from the engines must be collected and taken to the hot well or sump. Jacket water must be taken off by steam traps, and led to the hot well. Steam traps are things engineers are very strong on, and are laid about thickly; it is quite customary for one engine to have four traps connected to it, and they are a greater source of trouble than almost anything else in the station. Then the pipes must be properly covered, and pass tests which are rigidly enforced to 1° Fahr. as to the amount of heat which escapes through the lagging. In the case of an alteration and extension to the pipe work in a comparatively small station I know of, there are no fewer than 70 valves to be provided. So it will be seen that it is not all plain sailing putting in the pipes.

Material and Construction of Pipes.—The main steam pipes are generally specified to be made of lap-welded mild steel. In the case of bends the lap must be in the neutral axis, the only difference being in the manner of fastening on the flanges. And here we have a great variety of opinion as to which is the best method. One way often used is by screwing wrought-iron or cast steel flanges on the pipe and riveting over the ends, and also brazing the other side of the flange. The principal objection to this is that the screwing weakens the pipe so much by nicking deeply into it, and there is too much room for bad workmanship to pass unnoticed. A good form of flange is made of a strong angle iron bored out to fit on the pipe, and shrunk on, then riveted to the pipe. Sometimes cast-iron flanges are used, and are made very strong. They are screwed on to the pipe, and sometimes are riveted as well. Electrically welded pipes are coming into use, and have their faults as well as the others. In welding anything a good deal of trust is put in the men who do it. There is here, again, plenty of opportunity for indifferent workmanship, especially where the flange joins the pipe. The first cost of these pipes is large, and you must not order any special size of flange to suit existing flanges, as the price for special flanges runs out to somewhere about £2 per flange extra. Copper is seldom asked for, excepting for bends. Sometimes bends of copper are put on exhaust pipes. Cast-iron, of course, is the cheapest form of pipe, but the argument regarding bad workmanship comes into full force here. I do not wish to insinuate that the average mechanic is always on the look out to put in bad and slovenly work, but pipes are often quite neglected all through; great care is taken in the moulding, machining, and testing of the cylinders of an engine, but very often the pipes are never tested at all. To an iron-moulder a pipe is a pipe, it does not matter whether it is a steam pipe or a drain pipe, they get the same care in moulding, and many an accident has occurred through uneven thickness of metal. Another objection to cast-iron is, that pipes do not always fit into their places properly, and the erector tries to pull them together, often straining the flanges to the breaking point, and when one does break, it does so without warning. Cast-iron, like everything else, has its champion, and he is to be found at the General Electric Company's works at Schenectady. They had wrought-iron piping with cast-iron flanges and packed joints; the consequence was they had a gang of men constantly employed on Saturday night and Sunday repairing joints, so the engineer thought if he stayed at home and did not see what others were doing he could not expect to get the best results. So he went to Boston, New York, and Brooklyn, and several other places, and in the whole course of his journey he failed to find a single plant that was not troubled with escaping steam where they were carrying high pressure; he then decided that he must use cast-iron pipes, and gave for his reasons:—

1. "If cast-iron was good enough for valves, it certainly must be all right for plain piping, as it was a much simpler casting to make perfect."

2. "I conclude that, by using cast-iron, I could cut the number of joints down to about one-quarter of what would be required by the use of any other metal."

The pipes he was dealing with were 14 inches diameter, steam pressure 160 lbs. The metal was $1\frac{1}{4}$ inch thick in the body, and $2\frac{1}{2}$ inches in the flange. The flanges were bolted together by 20 bolts, $1\frac{1}{4}$ inch diameter. This proved successful, and "he was happy ever after." The smaller piping to pumps, &c., is either of wrought-iron or copper, boiler feed pipes, wrought-iron, but not always, as at the Yorkshire House-to-House station they are cast-iron, 4 inches diameter. Occasionally every detail is given as to how the pipes should be made, and here is a portion copied from a specification:—"The steam pipes, of steel, shall be made of plates $\frac{1}{2}\frac{1}{2}$ inch thick. (I suppose $\frac{3}{8}$ inch, which is $\frac{1}{32}$ inch more, would not do.) The angles of flanges $\frac{3}{4}\frac{1}{4}$ inch diameter in the body and $1\frac{1}{4}$ inch thick. ($\frac{3}{4}\frac{1}{4}$ is known in the shops as $\frac{1}{32}$ inch under $\frac{7}{8}$ inch, and, to say the least, it is strange why $\frac{7}{8}$ inch should not do.) They must be faced on the surfaces and the edges, and bored for the bodies of the pipes, with slightly recessed spigot and socket joint. The flange shall be secured to the body of the pipe by 16 rivets, $\frac{3}{4}\frac{3}{4}$ inch diameter, and the flanges bolted together by 11 $\frac{7}{8}$-inch bolts. The stop valve shall have wrought-iron cross-bars and pillar bolts with spindles, glands, valve, and seats of gun-metal. The cross-bars shall be shaped in a slotting machine (and not turned) and chased to receive the screwed spindle. All bolt holes shall be bored to the correct size, and all bolts shall be turned throughout their entire length and at the point, and faced up under the head. All nuts shall be truly faced, and shaped both top and bottom, and finished bright. The pipes shall be fitted accurately together, so that the flanges shall come metal to metal without straining, and the joints shall be made without any kind of inserting rings, and the flanges shall be screwed practically metal to metal and made perfectly steam and water tight."

In this case it will at least be admitted that "pipes" have had some attention paid to them as to how they should be manufactured. In going through these specifications it is often amusing to notice how comparatively trivial details are gone into thoroughly, and the most important parts scarcely referred to. You can always tell one prominent electrical engineer's specifications by the size of stop valve, where he stipulates 18 inches is his favourite size, and it does not matter much what size you make the cylinders as long as you supply an 18-inch stop valve wheel. One would think that in the specification I just quoted from regarding the pipes, that everything else would be dealt with similarly, but such is not the case. The connecting rod had to be 5 feet 8 inches centres, but the stroke of the engine was never referred to. You could make that what you liked. It is difficult to say what special virtue there is in a 5 feet 8 inches connecting rod, evidently it is quite regardless of the stroke. If this specification had come from a manufacturer, the conclusion that would at once be arrived at would be that he had some old ones to use up.

Engines.—As almost every type of engine is being used for the production of electricity, it will not be amiss to look for the reason of this, to consider some of the leading characteristics, and to come to some conclusion as to which is the best kind. There is no other class of engine of which so much is required. It must be an engine that can be relied upon to be always fit for work; it must be able to start up quickly, to run for long periods without stopping, and above all, to run steadily always, no matter how the load varies, which it does to a great extent, anything from $\frac{1}{4}$th full load to 20 per cent. over load can be expected daily. When compared with a locomotive, we find that the engine only runs from two to three hours at a stretch, then has a long stop, and once a week is overhauled in the running shed; if anything goes wrong, such as a bearing getting hot, it can be eased up or stopped altogether without causing much inconvenience; but the electrical engine cannot be stopped, when perhaps a town is depending on it for its light. We often hear of the wonderful performances of marine engines, making runs out to Australia without stopping; but by the time they get near the end you will find glands blowing hard, water flying about all over, big ends knocking like steam hammers. I have known the engine room to be so full of steam, that the chief engineer, when coming down the ladder, thought he had reached the bottom when three steps up, and damaged himself. There must be no escape of steam from the electrical engine, as any moisture on the alternator is deadly. For the same reason water must not be used for cooling bearings, and great care has to be exercised in designing the oiling arrangement, so that more can get on to the machine. The standard mill engine has a much easier life, its load is practically constant, one or two men look after it constantly, while every Sunday it is available for repairs. It would be rash to say what will be the future standard type of electrical engines. The marine engine has come through its period of evolution from the steeple, beam, side lever and horizontal to the present day inverted type, which has no rival. The mill engine is invariably the heavy, slow running Corliss engine, and is also unassailable. While the engine for electrical work as yet has no recognised form, every kind is being used at present, and are undergoing the process which leads to the survival of the fittest; very often in the same station you will

find four or five different styles, and all by different makers. If we take the Leeds central station as an instance, we will find they have large horizontal slide valve engines, Corliss engines, other patent valve gear engines, and high speed enclosed engines; and this is no exception to the rule. The great variation in the speed, which is anything from 60 revolutions to several thousand in the case of Parsons's turbines, to a great extent accounts for this, and to-day the style of engine is largely settled by the speed of dynamos or alternator. Direct driven plants which hold the field just now require a good speed, which debars the Corliss engine, so it can be struck off the list. As every electrician knows, it is much more difficult to run in parallel with direct driven plants that with belts or ropes, and for good parallel running you require to run at least at 150 revolutions with two crank engines, and the higher the speed the easier the running, but with three crank engines 125 revolutions gives capital results when in connection with an ironclad type of alternator. The only drawback to a plant running so slow as this is the increased first cost, and the makers of high-speed motors get many an order on that account. The horizontal order of engine is rapidly being replaced by the inverted owing to amount of space occupied, and it is now possible to put a 600 kw. plant on less ground than was used a few years ago for 80 kw. Looking at the high speed kind, that is, engines running at 300 to 500 revolutions per minute, they take up a minimum amount of room and cost less, but they are never so economical, and have a comparatively short life, and when anything goes wrong it means a smash up all over. Many of them are entirely dependent on forced lubrication, which occasionally gives out, while they have in their favour good governing and parallel running qualities.

In my opinion, the engine which fulfils most of the present day requirements and gives most satisfactory results, is the ordinary triple expansion inverted surface condensing engine. They have three cranks, giving a good turning movement; they have a large number of expansions of steam, giving economy; they can be made to govern perfectly; they have a condenser which provides a good vacuum; air, circulating, and feed pumps are worked by the main engine, and it is entirely self-contained.

There is a great deal to be said in favour of having an engine entirely self-contained, it is all together. There are no little independent pumps to deal with, and to start up simultaneously with the large engine, and it has its own condenser, which is a great advantage. With many engineers a vacuum is not of much consequence. It does not much matter whether the gauge shows 18 inches or 28 inches. There is no great secret in getting a good vacuum. All you require is plenty of cooling surface, plenty of water, and a good air-pump, and you get it; and it is worth having, because if we take the referred mean pressure in the low pressure cylinder to be 21 lbs., and let us suppose the vacuum in the cylinder to be 20 inches, and it often is much less than this, if it be increased to 26 inches, that means a difference of pressure of 3 lbs., which brings the mean pressure up to 24 lbs., and adds 14 per cent. to the power of the engine, which is given almost gratis; and we may take it as a rule that an engine with its own condenser will do considerably more power than one with a separate condensing plant. With most engineers a condenser is a condenser, and it does not matter whether it is close up to the engine or in as remote a part of the engine house as possible. With independent condensers, which do the work for several engines, you never get a good vacuum in the cylinders. 20 inches may be taken as a maximum. Very often it happens that it is only that in the condenser, especially in the case of a jet condenser.

Then, again, when all the engines in a station are connected to one condenser, and it breaks down, it is a serious matter, and is equivalent to putting on suddenly 25 per cent. more load at least all round, which would be awkward when the plants were working at full power. It may be argued that there should be a spare condensing plant, but that means considerable expense and more complications in the pipe work. Not only should every engine have its own condenser, but it should work it especially in small sized units, as in a certain case where a small engine has a separate condenser worked by independent pumps, the arrangement is such that, instead of driving these pumps, it is more economical to run non-condensing.

When extreme economy is demanded, the cost of the engine materially goes up, as in the slower running engines a very complete system of jacketing must be carried out; cylinder ends and pistons must be polished, and every part of the cylinders must be well covered with lagging. The bearing surfaces must be very large all over to provide for continuous running, and very often are specified to be made of Magnolia metal. The valves must be balanced against the steam pressure, and, as previously stated, the engine must be large for its work, that is to say, the terminal pressure in the low pressure cylinder must be low.

Unfortunately, however, economy often gets scant consideration, and a few pounds in the first cost decides where the order will be placed. When settling upon the size of engine required, it sometimes is difficult to know what size to call it, as very often it is put in this form. The generator must be capable of producing 200 amperes at from 2,000 to 2,200 volts when running at 150 revolutions. The engine will be supplied with steam at 125 lbs. pressure in the boilers (which are 40 feet away); it will be connected to a condenser 50 feet away, when the guaranteed vacuum will be 25 inches; it must be capable of working most economically at full load, and be able to do 25 per cent. overload without any reduction in the speed, and also must do the full power when working non-condensing. Guarantees as to the steam consumption at different powers under these conditions are then asked for.

The clause concerning governing is a very important one, and very stringent, and sometimes impossible conditions are laid down. It is customary to stipulate that "the governor must be able to control the speed within 1 per cent. of the normal from half load to full load, and when all the load is suddenly thrown off, the speed must not vary more than 4 per cent." Another stipulation, which is thrown in, is that "the governor must have provision for altering the speed of the engine as much as 10 per cent. above to 10 per cent. below the normal while the engine is running." Much more trouble has been caused by attempting too fine governing, than by aiming for moderate governing. The finer the governing, the greater the danger of touching the hunting point, and when that is reached, away goes the parallel running, and the engine would run infinitely steadier without one. When a good governing engine is placed alongside bad governing ones, it has a rough time of it, as when the load increases, the other engines gradually slow down, and don't do their share of work, while the good engine is struggling along to keep up to its speed with a greatly increased load, and probably pulling some of the others round. Electricians are gradually coming to the conclusion that it is better to govern to 5 per cent. than to 1 per cent., and for facility of getting in and out of parallel, even rougher than that is suggested.

Again, with fine governing it is impossible to have a large range in the variation of the speed, which is wanted for synchronising purposes.

Alternator.—I will refer very briefly to the leading particulars usually specified in the case of an alternator.

Type.—Either open coil revolving armatures with fixed magnets, or a fixed armature and revolving magnets, commonly known as copper machines and ironclads respectively. The copper machine is a more efficient one than the ironclad, but not so reliable, and is more difficult to manipulate in paralleling. It takes a very high class plant to give a combined efficiency of 75 per cent. with an ironclad alternator, while with a copper machine 85 per cent. can be got easily.

Periodicity.—The number of complete periods of alternations per second is stated, and as a rule is either 50 or about 80.

Temperature Rise.—After a 12 hours' run at the normal output no part of the armature or magnet shall have a temperature of more than 60° F. above that of the surrounding atmosphere. If the temperature exceeds that limit by more than 10° F., the alternator may, at the option of the engineer, be totally rejected.

Parallel Running.—The machine must be so constructed that it is capable of running in parallel at all loads. The time to speed up a plant lying idle, with the cylinders warm, and to put it in parallel with a plant running fully loaded, must not exceed two minutes.

Minimum Insulation Resistance.—The amount of resistance stipulated by different engineers varies enormously, as the two following cases will prove:—

15 megohms. Armature conductor to framework in one case; 3 megohms in the other. 5 megohms field magnet to framework in the first instance; 100,000 ohms in the last.

The insulation between the armature and the framework must be capable of resisting piercing by a spark of anything between 4,000 and 6,000 volts alternating E.M.F., according to the opinion of the engineer. So it will be seen that there is some diversity of opinion as to the amount of resistance necessary.

Exciter.—An exciter of approved design must be provided with the alternator, and the percentage of excitation required by the alternator must be stated.

Then an efficiency must be guaranteed.

These represent the usual stipulations issued by the electrical engineer, and except the clause as to resistance, they are practically the same in every specification.

Conclusion.

"*Electrical Engineers' Specifications*," although they are most emphatic and concise, are by no means always adhered to. In some cases horizontal engines have been asked for, every detail mentioned, drawings got out, and the specification prepared accordingly, while they ultimately take vertical engines. Again, the speed is specified that it must not exceed 100 revolutions, and they straightway go and buy one running 330 per minute, and so on. They are all very well in their way, but when a specification is given which goes into great detail, and demands many extra fittings, and an abnormally large outfit, the tendency is to make the contractor do as little more as possible, and if anything be forgotten, it must be paid for extra. Then it is rather annoying when an insertion is insisted on which partakes largely of the nature of a fad, and upsets present arrangements. When every part of the design is stipulated, it effectually puts a stop to any improvement that might have been effected had the manufacturers a freer hand, and, as a rule, the purchasers would get just as good a plant if they put it into the hands of any of our leading firms who have a reputation to keep up, without binding them down at every point. Some of our old-established firms, who do not encourage electrical work, give as their reason, their aversion to the specifications. Finally, a firm can tender away every day, they can specify in the case of the engine that it shall fulfil every condition mentioned in the specification; it shall govern perfectly, run continuously, give 94 per cent. mechanical efficiency, use not more than 12 lbs. of steam per I.H.P. per hour, the workmanship and finish perfect, the price an average one, yet all this is merely a waste of time, ink and paper, for unless this is followed up by personal attention to the purchaser, and the sitting on his doorstep for a while, they won't get the order.

Amendment of Specification.—The Basle Chemical Works, of Basle, Switzerland, have applied for leave to amend Specification No. 4,985, of 1895, granted to Harold Imray for the "Manufacture of colouring matters of the group of the Phthaleines." See our "Official Notices" this week.

RESEARCHES ON HIGH TEMPERATURES AND THEIR PRACTICAL EMPLOYMENT.

An important paper has recently been published by Goldschmidt in the *Zeitschrift für Elektrochemie*, in which he briefly reviews previous works on the use of aluminium in producing high temperatures, and then describes the method he adopts. As is well known, an extremely violent reaction takes place when aluminium unites with oxygen, the estimated temperature of the reaction being about 3,000° C. In order practically to make use of the high temperatures thus obtained, the chief difficulty is so to moderate and control the reaction that it will perform the required work.

The first point to be noted is that it is not necessary to heat up the whole of the reacting mass to the temperature of ignition. It is sufficient to start the combustion at a single point only, but this in itself presents some difficulties. In the preparation of metallic chromium from a mixture of its oxide with powdered aluminium, these difficulties may easily be overcome by applying at any convenient point a small quantity of a mixture of aluminium with a more easily reducible oxide, or preferably a peroxide. Lead oxide, copper oxide, potassium permanganate, and many other substances may be employed for this purpose.

One great advantage of this process is that it admits of the preparation of pure metals free from aluminium; the only precaution which requires to be observed is that the oxide to be reduced must be present in slight excess.

The process is capable of two main applications. In the first place the heat given off by the combustion of a mixture of aluminium with any convenient oxide may be utilised for heating purposes only (welding, &c.), or, secondly, the reducing power of aluminium at a high temperature may be used for the preparation of pure metals or alloys. In either case only slight alterations in the mode of working are necessary. If a moderate heat be required, the reacting mass is diluted by the addition of some inert substance, which, at the same time, prevents the whole mass from melting. A convenient mixture of this sort is composed of aluminium and the cheapest available oxide (*e.g.*, iron ore, sand, &c.), which is then diluted either with a large excess of the same oxide, or with magnesia, lime, &c. If, on the other hand, the metal itself be required, a large excess of the oxide must be avoided, so that the heat which is generated will not only melt the metal, but also the slag (corundum), which then protects the regulus from the action of the air.

The following experiments illustrate the applications of the process: A rivet weighing 3 kilos., such as is used in the construction of bridges, is surrounded by a mixture of oxide of iron, sand, &c., and powdered aluminium, and almost wholly embedded in sand contained in a wooden box. On the top of the small exposed portion of the aluminium mixture is laid a small ball prepared by mixing aluminium powder with a more easily reducible oxide, and into which is inserted a short length of magnesium ribbon. The reaction is started by setting fire to the magnesium ribbon, and as soon as this is done, more sand is placed on the top in order to keep in the heat. If the contents of the wooden box are emptied out after a short time, it will be found that the rivet is white hot and ready for forging.

In a similar way 1 inch iron pipes may be hard soldered at an estimated cost of about 2d.; or, two pieces of wrought-iron may be fused (welded) together. The joint so obtained is satisfactory, as can be shown by sawing the pieces through at the joint. It is claimed that such a joint is better than that produced by electric welding, owing to the greater uniformity of heat. By diminishing the quantity of inert material, the iron in the above experiment may be easily melted. Holes may be made through ½-inch wrought-iron plates by igniting some of the reacting mixture on them, and adding more, if necessary, as soon as the reaction has started.

In order to reduce chromium from its oxide, a mixture of this and powdered aluminium is made and introduced into a crucible lined with magnesia. The reaction is started as before, and the mixture then added continuously until the crucible is full. After cooling, the crucible is broken open and the regulus of metallic chromium removed. At the meeting of the German Electro-chemical Society, at which the author communicated his paper, he showed a mass of chromium, weighing 25 kilos., prepared in this way. By making two apertures in the crucible, one for the introduction of the mixture and the other for the outflow of the chromium, the process may be worked continuously, as in the case of the electric furnace.

It is claimed that the temperature attained is higher than in the ordinary electric furnace, and that a given quantity of material can be put through in a shorter time. Moreover, the chromium is also free from carbon or carbides. The slag (alumina) produced in the furnace may be reconverted into aluminium and used over and over again, or it may be used for polishing, since it possesses certain advantages over emery.

Almost all metals may be reduced from their oxides in this way, and the yield is nearly theoretical. The different alloys, *e.g.*, "chrom-manganin," copper-chromium, &c., can also be prepared. The slag from the furnace contains minute rubies, which owe their colour to chromium.

For the preparation of pure metals it is necessary to use pure aluminium; but for heating purposes only, crude (50 per cent.) aluminium may be employed. Besides oxides the oxy-salts of certain metals may be reduced in the same way.

The author looks upon aluminium as a "*heat accumulator*," since it is possible to transport it, and by its union with oxygen develop, wherever necessary, an amount of energy corresponding to that which was originally required for its preparation.

The above is an abstract of an article which may be consulted in the *Zeitschrift für Elektrochemie*, iv., (21), 494.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1898.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, *to whom all inquiries should be addressed.*

20,295. "A new or improved instrument for the direct measurement of magnetic hysteresis." W. Peddie. Dated September 26th.

20,313. "An improved fitting for entirely concealing from view ceiling or other blocks (or other preparations for receiving roses) and roses for electric light pendants or fittings, without resource to screws or the like fastenings in ceilings, walls, or other contiguous surfaces." A. E. Pullen and C. J. Cooper. Dated September 26th.

20,353. "An improved cell switch." H. J. F. Voigt and J. A. Haeffner. Dated September 26th. (*Complete.*)

20,393. "Improvements in, or connected with, electrical motor-transformers." A. B. Holmes. Dated September 27th.

20,394. "Improvements connected with the controlling of electrical circuits." A. B. Holmes. Dated September 27th.

20,398. "Improvements in electrical switches." A. Watson. Dated September 27th.

20,446. "Improvements in connection with electric railways." G. W. Johnson. (S. Hutchins, United States.) Dated September 27th. (*Complete.*)

20,458. "Improvements in the generation, supply, and transmission of electricity." J. H. Barker. Dated September 27th.

20,469. "Improvements in apparatus for lifting, lowering, supporting, and conveying the drums on which electric cables are coiled for purposes of carriage or transport." T. Oxley. Dated September 28th.

20,496. "Improvements in insulators for telegraph wires and the like." J. Taylor and W. Taylor. Dated September 28th.

20,523. "Life saving spring bolts as applied to railway trains by steam or electricity." A. J. Disney. Dated September 28th.

20,528. "Improvements in standard cells for small electric currents." Siemens Bros. & Co., Ltd., and E. F. A. Obach. Dated September 28th.

20,531. "Electro-magnetic mechanism for actuating engine valves." J. McLaren and H. McLaren. (E. W. Nayler, United States.) Dated September 28th.

20,532. "Improvements in, or relating to, electrically-propelled vehicles." R. W. Blackwell. Dated September 28th. (*Complete.*)

20,621. "Improvements in, or relating to, automatic electric switches." C. Turnbull, jun., and G. S. Peck. Dated September 30th.

20,625. "Improvements in means appertaining to the electric haulage of vehicles." W. T. Smith and J. W. Astley. Dated September 30th.

20,661. "Improvements in and connected with distribution connection or terminal boards for telephonic systems." M. Byng and F. G. Bell. Dated September 30th.

20,672. "Improvements in or relating to arc lamps." T. Soderlund. Dated September 30th.

20,677. "Apparatus for starting electric motors." G. Bullock. Dated September 30th. (*Complete.*)

20,689. "Improvements in electric magnets or magnetic fields." C. M. Johnson. Dated October 1st.

20,734. "Improvements in or relating to telephones and microphones." R. Hammerstein. Dated October 1st.

20,739. "Improved feed mechanism for arc lamp carbons and carbon holders." T. Soderlund. Dated October 1st.

20,753. "Improvements in alternating current motors." W. Langdon-Davies. Dated October 1st.

20,759. "Improvements in the construction and working of electric arc lamps." La Societe Les Fils D'Adolphe Mougin. Dated October 1st. (Date applied for under Patents, &c., Act, 1883, Sec. 103, April 2nd, 1898, being date of application in France.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free,* 9d. (*in stamps*).

1897.

88. "Improvements in or relating to cathodes in galvano-plastic or electrotyping processes." A. Julien. Dated January 1st, 1897. The cathodes for use in electrotyping are coated, before use, with a mixture of plumbago and and a volatile liquid such as essence of turpentine, benzine, petroleum essence, petroleum, alcohol, xylol, or the like, to which may be added, to give hardness and adhesion, resin, colophony, gum arabic, yellow wax, paraffin, Canada balsam, or the like. 2 claims.

203. "Improvements connected with accumulators or secondary batteries in electrically-propelled vehicles." C. Rodenburg. Dated January 4th, 1897. Relates to electric locomotives and motor vehicles. When batteries are employed for driving the motors in parts of the line not supplied with conductors, they are charged by connecting them up in series with the motors on those parts of the line where the conductors are placed. Preferably, the batteries are in two parts, and may be connected as shown on the different parts of the line, but other arrangements with a single battery are also described. 1 claim.

2,445. "An improved thermometric electrical circuit closer." G. H. Zeal. Dated January 20th, 1897. Relates to a mercury thermostat which can be set to close an electric circuit at any required temperature in order to actuate a fire alarm or temperature regulator. The tube from the mercury bulb is divided into two branches, into one of which one terminal of the electric circuit is introduced, the other terminal of the circuit being introduced into the bulb. The board on which the thermostat is mounted turns on a pivot. By setting this board at the required angle by means of a scale and a pointer, the mercury can be caused to make contact with the pointer at any required temperature. 3 claims.

7,189. "Improved means for supplying current to electrical cars." M. Ott and A. Silbermann. Dated March 19th, 1897. Relates to electric railways: projections on the wheels depress spring pins in the rail into contact with an insulated conductor so as to complete the circuit. 3 claims.

20,663. "Improvements in electrically-operated jigging machinery." A. Bergtheil, H. Wilson-Young, and A. Brown. This is a machine to produce the close settling together of particles, such as tea, without direct pressure, by jigging them over a sieve bottom by electrical means at an exceedingly high speed of pulsation. To produce these rapid pulsations, either the intermittent attractions of an electro-magnet against spring reaction are used; or else applying opposing intermittent magnetic attractions to the jigging frame. 4 claims.

20,669. "Improvements in or connected with automatic brakes for electrically-driven machines." A. B. Blockbury and W. L. Spluce. Dated September 8th, 1897. An electric motor is connected to the driving gear through a mechanical clutch; having a predetermined amount of backlash. When the motor is running normally and transmitting power, the driven part will follow with the backlash behind it; but if, while still running in the same direction, the load on the mechanism become negative, the speed of the driven part will increase beyond that of the motor, and the part which has previously been lagging will now lead, and drive the motor as a generator. 6 claims.

1898.

1,849. "Improvements in electric railways on the conduit system." N. H. Balfour and E. W. Smith. Dated January 23rd, 1898. Relates to electric railways and tramways with road contacts or sectional conductors, which are connected to the main conductor by a trolley running in an enclosed circuit, and kept in touch with the vehicle by electro-magnets. The cover of the conduit is built up of transverse iron bars separated by non-magnetic material and held together by bolts. These bars complete the magnetic circuit between the trolley and the vehicle. The road contacts or sectional conductors inside and outside the conduit may be attached to the cover or otherwise placed. 3 claims.

10,557. "Improvements in, and relating to, electric furnaces." T. Jackson. Dated May 9th, 1898. A combination of blocks and plugs of fine platinum coils encircling the respective parts of an inner shell, composed of a compound of fireclay, so that any part of the whole inner shell may be brought into requisition. There is also a method of governing the furnace, so that any particular part of the whole may be heated separately or simultaneously. 3 claims.

10,585. "Improvements in electrical resistances." The Chemisch-Elektrische Fabbic Prometheus Gesellschaft nut beschanketer Haftung. Dated May 9th, 1898. Electric resistances, consisting of layers of copal varnish burnt on metallic surfaces as insulating material, and layers of precious metal burnt on these copal layers as resistance material. The copal layer will not carbonise at the same temperatures at which metallic lustres or enamel colours are deposited. 1 claim.

10,599. "Improvements in electrical devices for igniting liquid burners." The Reform-Petroleum-Beleuchtung and E. Weinhagen. Dated May 9th, 1898. When this invention is used with a lamp, a semi-globular receptacle is used in which is placed an electrical contrivance capable of generating and maintaining an electrical current of predetermined strength. This receptacle has a removable top, which is provided with a similar depression in its upper surface. Secured to and near the centre of the lower surface of this top is an electrode, and surrounding the walls of the depression and vertically movable is a second electrode. These two electrodes form the poles of a galvanic element. Above the electrical generator is an oil reservoir with a depending projection on its lower side which fits the depression of the receptacle cap. On one side of this reservoir is a vertical opening formed in the upper surface of the generator top; passing through these openings and engaging the electrode at its lower end is a post sustained in a supported position by a spring. On the upper side of the reservoir a burner is mounted with an igniting spiral near its wick. The burner has a spring connected with it that has electrical connection with the generator. 9 claims.

11,051. "Improvements in ceiling roses for electrical purposes." W. P. Thebrmann. Dated May 4th, 1898. A ceiling rose is provided with an insulating partition, formed or secured on the base to separate the connecting plates. The flexible conductors are passed through separate holes, in the partition, and through V-shaped openings in its sides to the connecting plates. 4 claims.

13,709. "Improvements in or relating to the electric propulsion of railway trains." O. H. E. Kaselowsky. Dated June 20th, 1898. The electric energy is generated on a moving power station, and supplied to motors distributed over the whole length of the train. There are two separate controlling places, each provided with a controlling apparatus in which controller bars are connected with the dynamo and also with a secondary battery placed in the travelling power station, by means of a conductor provided with couplings between the cars. The separate contacts of both the controlling apparatus are provided with corresponding couplings between the bars, so that by means of contact bars can either be conveyed through the car, or, after removal of respective contact bars, be utilised to connect to the motor conductors of each separate car for the purpose of attaining an easily controllable and simple composition of the train, and thoroughly reliable and extremely economical actuation. 1 claim.

13,793. "Improvements in electrical generators." P. A. Emmanuel. Dated June 21st, 1898. This invention consists in passing steam or hot or cold water through a metallic tube coiled in the form of a series of involute and evolute spirals, and allowing this fluid to escape into a metallic funnel-shaped receiver. The electricity generated by passing the fluid through the spiral coils is then caused to induce a secondary current in helices of a conductor surrounding the generating coils and receiver. 20 claims.

13,960. "Electrode for accumulators." H. Damm. Dated June 23rd, 1898. An electrode on a frame of lead wire web, which serves as a support to the effective or active mass of the electrode. 1 claim.

15,733. "Improvements in electric telephone transmitters." A. M. Massari. Dated July 18th, 1898. In this transmitter the diaphragm is regulated by a spring which causes pressure to be exerted on its back. There is a means for regulating the tension of the spring. The mouthpiece is removably attached to the transmitter and insulated from it. It is connected to its base by means of a forked sliding piece, which carries one of the terminal wires. The fork takes into a groove on the stem of the instrument. 4 claims.